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DESIGN OF MOBILE PHOTOVOLTAIC POWER SYSTEMS: 0.5-3 kW

1 October, 1981

Final Report

Prepared For
Mobility Equipment Research & Development Command
Ft. Belvoir, Virginia

Roy D. Gibson

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PREFACE

This effort is an extension of earlier design and hardware development by MERADCOM personnel which included a 2.65 kW photovoltaic system for a telephone communications van and a trailer mounted 800 watt photovoltaic system for general purpose power. The author wishes to acknowledge the support of two major consultants on this project -- Monegon LTD (Hal Macomber) and Fred Costello Associates, (Fred Costello). Furthermore, the author wishes to thank Sam Cerami and Tony Smith of MERADCOM for their invaluable assistance and direction during this project.

SECTION 1

INTRODUCTION

In the conduct of its various operations the U.S. Army requires the support of mobile electric power generating sources. At the present time most of this need for mobile electric power is met by engine-generator sets. The U.S. Army Mobility Equipment Research and Development Command (MERADCOM), however, has the responsibility to develop new or improved cost-effective equipment which will meet future U.S. Army needs for mobile electric power generating sources. Among the potential new power systems which MERADCOM has been examining are solar photovoltaic power systems.

MERADCOM's examination of photovoltaic systems has consisted of a sizable number of system demonstrations ranging from relatively small systems such as secondary battery chargers to larger systems supplying a portion of the base power for a remote radar tracking and communication site. Included in these demonstrations have been two mobile photovoltaic power systems. One of the mobile systems provided 2.65 kW peak power for a telephone communications van. The solar cell array for this system was attached to the van body and designed to be opened for solar radiation collection during operations. An electric storage battery also was incorporated into the van design.

The other mobile photovoltaic power system demonstrated by MERADCOM was trailer mounted and consisted of the solar cell array, battery storage and power handling equipment.

Each of the photovoltaic systems demonstrated by MERADCOM were composed of existing "off-the-shelf solar cell modules, storage batteries and power handling equipment (where appropriate). In light of the advances technically and economically being made in photovoltaic power systems, as well as the favorable results from MERADCOM's photovoltaic demonstrations, MERADCOM solicited for a study of potential near-term characteristics of a family of transportable photovoltaic power systems. The study sought by MERADCOM called for a determination of optimum sizes and power ratings for the family of transportable photovoltaic systems which could be used in a variety of locations throughout the world with variable and unpredictable loads in the range of 0.5 to 3 kW.

At the beginning of this contract effort, a meeting was held at MERADCOM to refine the transportability requirements for the photovoltaic system. Specifically, MERADCOM defined two trailer sizes as system design constraints. Their two trailer sizes were based on

1. What a 2 1/2 ton truck could pull cross country (maximum loaded weight of 6,000 pounds).
2. What a 3/4 ton truck could pull cross country (maximum loaded weight of 1,000 pounds).

These physical weight and extrapolated size limitations together with the conditions that the array could be mounted in a reasonable time by two soldiers and that the battery was accessible for maintenance with the array in a stowed configuration led to the definition of study boundary conditions.

This contract effort can be summarized by four technical tasks which were:

- o Task 1 - Analysis of Engine-Generator Inventory and Use for <5 kW system.
- o Task 2 - Parametric Analysis of the Transportability of Photovoltaic System, i.e., the range of size and weight of transportable trailers and the associated PV generator size;
- o Task 3 - Preliminary Cost Estimates for Photovoltaic Systems;
- o Task 4 - Preliminary Photovoltaic System Design.

Section 2 of this report presents the results of Task 1 for the engine generator set planned inventory and characteristics. Task 1 also contained candidate photovoltaic system configurations which would be compared with the engine-generator characteristics identified in Task 1. Section 3 of this report presents the results of the parametric study of sizing trade-offs between photovoltaic arrays and battery storage capacities which were capable of at least meeting the identified engine-generator characteristics.

The parametric analysis of photovoltaic system transportability conducted in Task 2 focused on structural designs for the photovoltaic array and storage battery for the two trailer configurations. The results of this effort are presented in Section 4.

The preliminary cost estimate support in Task 3 involved life cycle cost analyses for the system sizes studied in Task 1. The results of the cost analyses are presented and discussed in Section 5 of this report.

The Task 4 preliminary system design support consisted of examining the results of Tasks 1, 2 and 3 and determining characteristics of transportable photovoltaic systems. Section 6 presents the results of this design support.

Section 7 of this report contains general conclusions of and recommendations for future efforts.

Descriptions of the computer runs made and copies of the computer output are contained in Appendix A for reference. Appendix B contains detailed analysis of structural forces for the various designs.

SECTION 2

ENGINE-GENERATOR CHARACTERISTICS

The Department of Defense (DOD) publishes a "Military Standard" (MIL-STD-633, the latest revision being 633E) for engine-generator set characteristics entitled "Military Standard-Mobile Electric Power Engine Generator Set Family Characteristic Data Sheets". This Military Standard was prepared for use by all departments and agencies of the DOD in selecting Mobile Electric Power Engine-Generator Sets for applications requiring mobile electric power. The mobile electric power engine-generator sets included in MIL-STD-633 comprise spark ignition (gasoline), and compression ignition (diesel and multi-fuel) engine and gas turbine generator sets which are currently in use within the military services.

The DOD military standard covers the electrical output and general characteristics for the DOD Standard Family of Mobile Electric Power Engine Generator Sets. These mobile electric power engine-generator sets vary in output capacity from 0.5 kW to 750 kW and include electrical power outputs of 28 VDC; 60 Hertz and 400 Hertz in conventional voltage ranges.

A summary of the U.S. Army projected inventory of mobile electric power engine-generator sets for fiscal year 1990 is presented in Table 2-1. For the smaller rated sets from 0.5 kW to 5 or 10 kW, the prime movers for the power generator sets generally are spark ignition engines (gasoline). The larger generator sets from 5 kW and above generally use compression ignition engines (diesel or multi-fuel) as the prime movers.

The study is concerned with engine-generator sets in the 0.5 kW to 3 kW range. A summary of representative data for these engine-generator sets is listed in Table 2-2. These data are taken from MIL-STD-633.

Table 2-1

Projected Army Inventory of

Generator Sets for FY1990

	Generator Set Rating (kW)		FY 1980	FY 1990	Estimated Fuel Consumption-1980 (Gallons) (1)
1.	0.5	GED	3,910	4,149	275 K
2.	1.5	GED	38,604	43,489 (2)	5,863 K
3.	3.0	GED	34,453	49,317	8,140 K
4.	5.0	GED	27,713	28,625	10,912 K
5.	5.0	DED	868	9,138	136 K
6.	10.0	GED	14,037	17,214	9,415 K
7.	10.0	DED	97	2,545	29.7 K
8.	10.0	GTED	--	2,340	--
9.	15.0	DED	2,696	7,546	1,137.7 K
10.	30.0	DED	2,971	7,486	2,507 K
11.	30.0	GTED	1	4	2 K
12.	60.0	DED	7,271	7,996	12,269 K
13.	60.0	GTED	55	384	207 K
14.	100.0	DED	--	2,685	--
15.	200.0	DED	142	155	1,268 K
16.	500.0	DED(3)	25	30	15.3 K
17.	750.0	DED	14	14	31.4 K

Note: 1. Fuel Consumption estimated on operation at one-half rated load, 500 hours, 75% of assets in use over a 12 month period.

2. Standby use. Estimated use - 1 hour per month.

3. DED - Diesel Engine Driven; GED - Gasoline Engine Driven; GTED - Gas Turbine Engine Driven

In addition to the electrical characteristics of the engine-generator sets, it is important to the selection of photovoltaic system characteristics which compare with the engine-generators to determine an appropriate reliability factor for these sets. Since system reliability affects system operational availability, the reliability factor chosen should be based upon system operational availability.

While the rated electrical output of the engine-generator sets listed in Table 2-2 should not vary with increasing elevations of application sites for the system sizes listed, larger engine-generator sets must be derated at higher elevations due to thermal considerations. This is contrast to photovoltaic arrays which are likely to have larger outputs at higher elevations due to the combined effects of an average higher clearness factor and lower temperatures than will be found at sea level.

Engine generators also can be characterized as power systems which generally have small initial capital costs. The operational, maintenance and fuel costs for these systems, however, are likely to be high. That is, these sets generally cannot be operated unattended thereby causing labor costs for operations. The requirement for major overhaul after only

Table 2-2

Representative Gasoline Electric Generating Sets

Basic Data

Electrical Details				Engine				Dimensions and Weight			
Continuous kW	Service Power Factor	Voltage V	Frequency Hz	HP	RPM	Cooling	Life Hours	Length (in.)	Width (in.)	Height (in.)	Net lbs.
0.5	1.0	120	60	1.5	3,600	Air	1,500	19	17	17	70
1.5	1.0	120	60	3.0	3,600	Air	1,500	27.4	20.4	18.5	125
3.0	0.8	120/208	60	6.0	3,600	Air	1,500	35	23.8	25	285
5.0	0.8	120/208	60	10.0	3,600	Air	1,500	39.8	30	25	488

1,500 hours together with whatever time is required for less major repairs will tend to make maintenance costs high. Further, the fuel costs including the price paid per gallon, the cost for storing the fuel and the cost for transporting the fuel to the storage site, or to the operating site will be high and are rising at a rate considerably higher than the inflation rate.

A current advantage of the engine-generator sets is that it requires relatively little land area per kW power delivered. the engine-generators from 0.5 kW to 5 kW require only a land area of 2.24 ft^2 (.21 M^2) to 8.28 ft^2 (.77 M^2) not including area for fuel storage.

A particular advantage of the solar power system over the engine-generator set is its silent operation and, therefore, reduced detectability in a combat situation or interference in any operational situation.

In addition the PV power system can operate unattended, requires no fuels or lubricants and does not pollute the atmosphere or any exhaust.

SECTION 3

PHOTOVOLTAIC SYSTEM SIZING ANALYSES

3.1 Parametric Analysis

The design parameters for a transportable photovoltaic power system place unique constraints on the design procedure for these systems which would ordinarily be highly site specific. Consequently, parameters which are usually independent variables in the design procedure become dependent variables, because of the various use requirements.

For these reasons this system design was performed in a parametric fashion with the objective of producing several well defined transportable systems which perform well in a variety of circumstances. Because performance is so highly dependent on the conditions of use, it was a further objective to provide parametric data in an easily understood format to assist decision makers in assessing the utility of these systems in a wide range of circumstances. The results of these performance objectives are presented in the remainder of this section and Section 6 which covers system characteristics.

The parameters affecting system size include:

- Location
- Power Load
- Load Schedule
- System Loss of Load Probability (resulting from solar insolation availability)
- Weight Limitation
- PV Panel and Battery Performance

To look at all the possibilities of these parameters over a wide range of applications and locations was not reasonable and so the following simplifying strategy was implemented.

3.2 System Sizing by Performance Versus Weight

Clearly a limiting condition on system size is the maximum weight which can be towed by the towing vehicle and so it was decided to look at those cases where the full utility of the weight capacity is realized.

Two trailer sizes were given as candidates, a one and one-half ton trailer and a one-quarter ton trailer. Their maximum payload weights for cross-country towing are 5,600 lbs. and 1,000 lbs., respectively. Data regarding the trailer weights and physical characteristics are provided in Table 3-1 and 3-2, respectively. Additional data used in sizing the system are listed in Table 3-3. Also contained in the table are the results of the sizing analysis described in the remainder of this section.

Photovoltaic panels have a power weight ratio and batteries have an energy to weight ratio which influence the optimum design. Further, any combination of array area and battery capacity in a specific location supplying a certain load schedule will result in a certain loss of load probability (LOLP) or availability (availability = 1 - LOLP) based upon the variability of solar insolation conditions at that site, i.e., the effect of consecutive days of inclement weather. If other constraints may be considered equal, availability is a desirable quantity to maximize.

As a general rule in a sunny region with a low probability of cloudy days, fewer days of storage and smaller arrays are required to match the performance of a larger system in less favorable climate. In the less favorable climate there will be some optimal balance of array and storage for any given availability or LOLP.

Table 3-1

Tabulated Data for One and One-Half Ton Trailers

a. Cargo Trailers.

	M104	*M104A1*	*M105A1*	*M105A2*	*M105A2C*
Dimensions inside:					
Height:					
To top of racks	3ft 9in	3ft 9in	3ft 9in	3ft 9in	3ft 9in
To top of side panels	1ft 6in	1ft 6in	1ft 6in	1ft 6in	1ft 6in
To underside of bows	5ft	5ft	5ft	5ft	5ft
Length:					
Body	9ft 2in	9ft 2in	9ft 2in	9ft 2in	9ft 2in
Rack	9ft 2in	9ft 3in	9ft 3in	9ft 3in	9ft 3in
Width:					
Body	6ft 2in	6ft 2in	6ft 2in	6ft 2in	6ft 2in
Rack	6ft 1in	6ft 1in	6ft 1in	6ft 1in	6ft 1in
Dimensions overall:					
Height, less paulin: (empty)	8ft 3in	8ft 3in	8ft 2in	8ft 2in	8ft 2in
Length	13ft 9-½in	13ft 9-½in	13ft 9-½in	13ft 9-½in	13ft 9-½in
Width	6ft 11in	6ft 11in	6ft 11in	6ft 11in	6ft 11in
Drawbar coupler (adjustable)	2ft 5-¾in and 2ft 9-¾in	2ft 7-⅝in and 2ft 11-3 / 5in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in
Towing vehicles	2-½T 6x6	2-½T 6x6	2-½T 6x6	2-½T 6x	2-½T 6x6
Weights: (all models)					
Payload:					
Cross country	3,000 lb				
Hard-surface road	4,500 lb				
Vehicles (net)	2,650 lb				
Total:					
Cross country	5,650 lb				
Hard-surface road	7,150 lb				

b. Water Tank Trailers.

	M107A1	*M107A2*	*M107A2C*
Capacity of tank (nominal)	400 gal	400 gal	400 gal
Dimensions overall:			
Height:			
To top of tank manhole cover	6ft 4-¾in	6ft 4-¾in	6ft 4-¾in
Length	13ft 7-⅛in	13ft 7-⅛in	13ft 7-⅛in
Width	6ft 10-¼in	6ft 10-¼in	6ft 10-¼in
Drawbar coupler (adjustable)	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in
Towing vehicle	2-½T 6x6	2-½T 6x6	2-½T 6x6
Weights: (all models)			
Payload:	~~3,335 lb~~		
~~Cross country~~	5,615 lb		
Hard-surface road	5,615 lb		
Vehicle (Net)	2,280 lb		

c. Trailer Chassis.

	M103A1	*M103A2*	*M103A3*	*M103A3C*	*M103A4*	*M103A4C*
Dimensions Overall:						
Height (to top of tire)	3ft 4in	3ft 4in	3ft 4in	3ft 4in	3ft 4in	3ft 4in
Length	13ft 7-⅛in	13ft 7-⅛in	13ft 7-⅛in	13ft7-⅛in	13ft 7-⅛in	13ft 7-⅛in
Width	6ft 10-¼in	6ft 10-¼in	6ft 10-¼in	6ft 10-¼in	6ft 10-¼in	6ft 10-¼in

Table 3-1 (Continued)

Tabulated Data for One and One-Half Ton Trailers

	M103A1	*M103A2*	*M103A3*	*M103A3C*	*M103A4*	*M103A4C*
Drawbar coupler (adjustable)	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in	2ft 6-¼in and 2ft 10-¼in
Towing vehicle	2-½T 6x6	2-½T 6x6	2-½T 6x6	2-½T 6x6	2-½T 6x6	2-½T 6x6
Weights:						
Chassis	1,560 lb	1,560 lb	1,560 lb	1,560 lb	1,560 lb	1,560 lb
Payload:						
Cross country	4,090 lb	4 090 lb	4,090 lb	4,090 lb	4,090 lb	4,090 lb
Hard surface roads	5,590 lb	5,590 lb	5,590 lb	5,590 lb	5,590 lb	5,590 lb

d. Folding Side Shop Van Trailer M448.

Dimensions overall:
- Height (empty) 8ft 5⅝in
- Length 13ft 9½in
- Width 7ft 7in
- Van body over chassis 5ft 6in

Weights

	Empty	*Cross-country*	*Highway*
Payload:	0	3000 lb	4500 lb
On wheels	2625 lb	5440 lb	6845 lb
On front gear	335 lb	520 lb	615 lb
Total	2960 lb	$\boxed{5960 \text{ lb}}$	7460 lb

Drawbar coupler (adjustable) .... 2ft 6¼in. and 2ft 10¼in
Towing vehicle .... 2½ ton 6x6
Shipping cubage .... 863 cu ft

1-19. Data and Service Plates (fig. 1-15)

The data and service plates are located on the right side frame toward the front of the trailer.

Table 3-2

Tabulated Data for One-Quarter Ton Trailer

Center of gravity forward of the rear axle	
Empty	23 in.
Loaded	41-1 / 2 in.
(2) *Overall dimensions.* (see fig 1-2 and 1-5 for shipping dimensions)	
Cargo body (inside)	
Length	8 ft
Width	3 ft, 5 in.
Height	11 in.
(3) *Weight.* (see figs. 1-2 and 1-5 for shipping weights)	
Payload	
Cross country	500 lb
Highway	750 lb
Weight on landing leg	
Empty	80 lb
Cross country	102 lb
Highway	104 lb
Weight on wheels	
Empty	350 lb
Cross country	828 lb
Highway	1076 lb
(4) *Lunette height.*	2 ft, 2 in.
(Two position)	1 ft, 11 in.
(5) *Axle.*	
Length	4 ft, 10-3 / 4 in.
Type	Tubular
Diameter	2-9 / 32 in.
Spindle	1-25 / 32 in.
(6) *Springs.*	
Type	Semi-elliptical
Length (centerline of eyes, flat)	3 ft, 1 / 4 in.
Width	1-3 / 4 in.
Thickness of leaves	0.206 in.
(7) *Shock absorbers.*	
Type	Non-adjustable, non-refillable
Length	
Collapsed	10.87 in.
Extended	17.44 in.
Average stroke	6.57 in.
(8) *Handbrake.*	
Type	Expanding shoe
Control	Hand
Actuation	Mechanical
(9) *Electrical system.*	24vdc
(10) *Tires.*	
Number	2
Size	
M416, M716, M762, M569	7.00 x 16
M416B1, M569B1	6.00 x 16
Ply	6 rating
(11) *Tire inflation.*	
Highway	25 psi
Cross country	22 psi
Mud, sand, snow	18 psi
(12) *Wheels.*	
Diameter of stud circle	5.50 in.
Number of studs	5
Rim size	16 x 4.50
Material	Magnesium alloy
(13) *Chests.*	
Length	62 in.
Height	16 in.
Number	2
Material	Steel

Note: Custom design should permit cross country payload of 1000 lb.

Designs needing to satisfy a variety of conditions do not have such an optimal point but there is sensitivity to the balance of array and battery over a variety of locations.

3.3 Computer Simulation

As indicated earlier and listed in Table 3-3, a variety of locations were selected representing a broad range of geographical and environmental conditions which might be experienced in Army operations. A computer simulation was set up to take array, battery performance and location as inputs and look at a full range of loads and duty cycles.

Output from the simulation was the LOLP for each load combination for each month of the year.

By a series of iterations which involved varying the balance of battery and array for a fully loaded large trailer and fully loaded small trailer, system sizes were established which had generally better overall performance than others.

For each trailer size, two array and battery size combinations were selected. The sizes selected for the large trailer were 40 m^2 of array with 35 kWh of battery and 60 m^2 of array with 20 kWh of battery while the size combinations for

Table 3-3

Transportable Photovoltaic System Sizing Data

PV PANELS	100 W_p/m^2 output (standard conditions)		
	54 lbs./m^2		
	Larger Trailer:	Case 1 -	60 m^2 array
		Case 2 -	40 m^2 array
	Smaller Trailer:	Case 1 -	13 m^2 array
		Case 2 -	5 m^2 array
		Case 3 -	3.5 m^2 array (1)
BATTERIES	20 Wh/lb. of useful capacity (2)		
	Larger Trailer:	Case 1 -	20 kWh
		Case 2 -	35 kWh
	Small Trailer:	Case 1 -	5.0 kWh
		Case 2 -	6.0 kWh

POWER LOADS

125 W to 2 kW with duty cycles ranging from 25 percent to 100 percent

LOCATIONS

Munich, West Germany
Jerusalem, Israel
Seoul, Korea
Albrook A.F.B., Panama Canal
Almeria, Spain
Cambridge, United Kingdom
Honolulu, Hawaii
Juneau, Alaska
San Antonio, Texas
Washington, D.C.

Note:
1. This smaller size of 3.5 M^2 was analyzed and concluded to be cost ineffective.
2. Based on 50% depth of discharge.

the small trailer were 5 m^2 with 5 kWh and 3.5 m^2 with 6 kWh. Battery sizing was based on a 50% depth of discharge. Beyond a certain point the benefit of increasing battery size at the expense of array area fell dramatically in many runs, completely eliminating the utility of the small trailer altogether. As a result, an alternate array size of 13 m^2 for the small trailer was also analyzed.

For convenient reference the data for both chosen systems in the ten locations are presented in Section 6. Availability is shown for each system and load on an annual average basis. The LOLP figures for extreme months are also shown to give a feeling for seasonal variations in performance. Availabilities worse than 80 percent have been masked with a dashed line and N/A is entered when the array simply cannot meet the load.

For more detailed information, the data tables from which the data in Section 6 were derived, are included in Appendix A.

An example of the computer output format is illustrated in Figure 3-1. For example, for the large trailer with a 60 m^2 array located in San Antonio, Texas and tilted at 29.5° from the horizontal (latitude) a load of 500 watts continuous (100% duty cycle) could be served with an LOLP of 1.9%. Likewise, for the small trailer with a 13 m^2 array, a load of 500 watts with a 25% duty cycle could be served with an LOLP of 10.9%.

3.4 System Performance

For reference in the following discussion, the ten sites are rank-ordered from the best system performance at the top to the worst at the bottom.

	Location	Latitude
1.	Jerusalem, Israel	31.8°N
2.	Honolulu, Hawaii	21.3°N
3.	Albrook AFB, Panama	8.6°N
4.	Almeria, Spain	37.0°N
5.	San Antonio, Texas	29.5°N
6.	Seoul, Korea	37.6°N
7.	Washington, D.C.	39.0°N
8.	Munich, W. Germany	48.1°N
9.	Cambridge, U.K.	52.2°N
10.	Juneau, Alaska	58.4°N

At a glance it appears that performance in regions approaching the poles is more directly a function of latitude while performance in equatorial regions is more site dependent. On the other hand, close examination of the data for the sites between Seoul and Jerusalem in the performance ranking shows very little distinction between them in annual performance.

LOCATION : SAN ANTONIO, TEX   LATITUDE : 29.5

LG. TRAILER ARRAY (SQ. METERS) : 60.0   BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0   BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.9	0.0	1.9	---	---	1.9	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	95.9	98.1	100.0	98.1	---	---	98.1	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.7	11.1	0.0	11.1	---	---	11.1	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	N/A	N/A
SM. TRAILER																
LOLP	0.0	10.9	---	---	10.9	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	89.1	---	---	89.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.1	71.1	---	---	71.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	---	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Figure 3-1. Example Format for Computer Output

How these distinctions and others affect system utility in various applications is taken up in more detail in Section 6.

In addition to an analysis of the performance of the mobile photovoltaic power systems which is based on an annual basis, it is important to consider the effect of seasonal or short term performance. As an example of seasonal performance, Table 3-4 presents the results of the 60 m^2 and 13 m^2 arrays which are tilted for optimum sun angle for winter and summer in Jerusalem, Israel.

Note that the tilt angle adjustment of 47° for the winter (December-February) in Jerusalem permits a 50% increase in performance for the 60 m^2 array over the annual performance at latitude tilt. Furthermore, a 17° array tilt for the summer months (April-September) permits a 100% increase for this array size.

These reults are important because military field maneuvers may often be conducted for periods of 1-4 months and monthly tables could be derived which would permit the maximum output performance of the arrays to be realized by appropriate array tilt adjustment.

Further results are illustrated in Table 3-5 for San Antonio, Texas where seasonal tilt adjustment permit winter performance which is at least equal to annual performance results and summer tilt adjustment permit a 50% increase in performance.

Table 3-4

Comparison of Annual vs. Seasonal Performance

Location: Jerusalem, Israel

I. Array Size: 60 m^2 (Large Trailer)
Array Efficiency: 10%
Battery Capacity: 20 kWh
Load: 2 kW
1-LOLP (Availability): 80% Min.

Max. Monthly Load Met vs. Tilt Angle:

Annual Performance	Seasonal Performance	
Latitude Tilt (31.8°)	Winter Tilt (47°)	Summer Tilt (17°)
2,000W @ 25% (DC)	2,000W @ 37.5% (DC)	2,000W @ 50% (DC)
	Dec - Feb	Apr - Sep

II. Array Size: 13 m^2 (Small Trailer)
Battery Capacity: 5 kWh
Load: 500 W
1-LOLP: 80% min.

Annual Performance	Seasonal Performance	
Latitude Tilt (31.8°)	Winter Tilt (47°)	Summer Tilt (17°)
500 W @ 25% (DC)	500W @ 25% (DC)	500W @ 25 % (DC)
	Nov - Feb	Apr - Sep

Note: DC - Duty cycle, e.g., 2,000 Watt @ 25% duty cycle is equivalent to 500 watts continuous.

Table 3-5

Comparison of Annual vs. Seasonal Performance

Location: San Antonio, Texas

I. Array Size: 60 m^2 (Large Trailer)
   Array Efficiency: 10%
   Battery Capacity: 20 kWh
   Load: 2 kW
   1-LOLP (Availability): 80% minimum
   Maximum monthly load met vs. Tilt Angle:

Annual Performance	Seasonal Performance	
Latitude Tilt (29.5°)	Winter Tilt (44.5°)	Summer Tilt (14.5°)
2,000W @ 25% DC	2,000 W @ 25% DC Oct - Dec	2,000W @ 37.5% DC May - Sep

II. Array Size: 13 m^2 (Small Trailer)
   Battery Capacity: 5 kWh
   Load: 500 W
   1-LOLP: 80% minimum

Annual Performance	Seasonal Performance	
Latitude Tilt (29.5°)	Winter Tilt (44.5°)	Summer Tilt (14.5°)
500 W @ 25% DC	500W @ 25% DC Oct - Feb	500W @37.5%DC May - Sep

SECTION 4

STRUCTURAL ANALYSIS

The Conceptual Design of the Structure

In order to better assess the practicality of transportable photovoltaic systems a number of conceptual designs were created for the mechanical and structural systems. Two of these were ultimately selected for detailed analysis to verify the feasibility of the most promising system. One design is intended for application with very small transportable PV systems (3.5 to 13 m^2 of array) appropriate for towing with a M 141 truck. The other is larger and can manage array sizes up to 60 m^2 but requires a larger towing vehicle, specifically a 2.5 ton truck.

Several designers were assigned to produce the initial conceptual designs independently so that a variety of independent thoughts and solutions could be available for synthesis in a final design procedure. Each designer, however, was given the same guidelines as follows:

- Total system weight should not exceed 21 lbs./ft^2 (103 lbs/M^2) of array

- Cost should not exceed $\$5/ft^2$ ($\$54/M^2$) of array
- Should be possible to set up by two men in 30 minutes for small trailer and 2 hours for the large trailer.

It was felt that if these minimum criteria could not be met that the system would not be practical.

The two figures following synthesize these designs as they were ultimately selected and integrated into the two final systems. Figure 4-1 and 4-2 shows details of the design concept for the small trailer PV system including many of the structural features which apply to the set up procedure. Figures 4-2 and 4-3, covers the same aspects of the large trailer system.

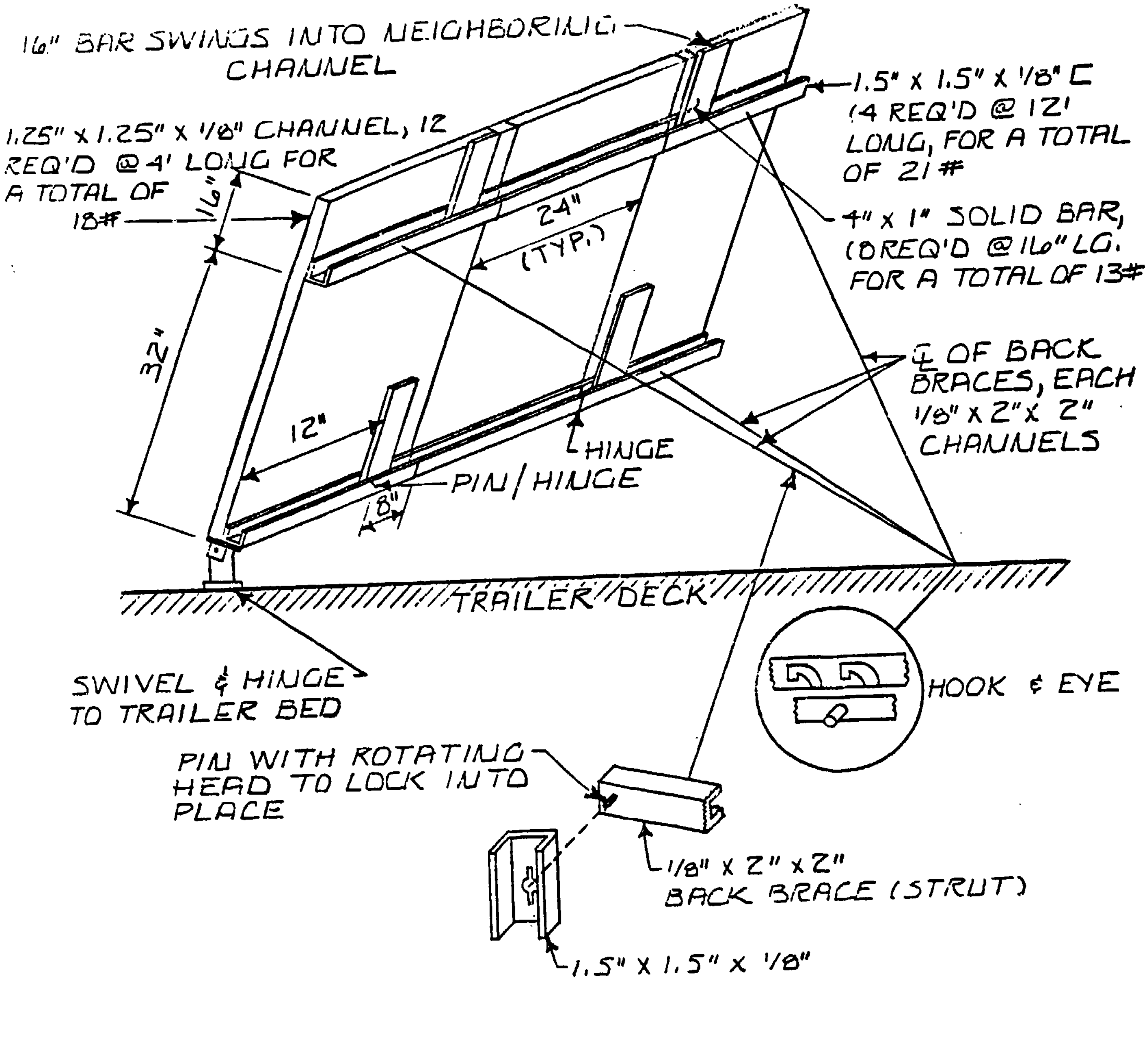


Figure 4-1. PV Panel Detail for Small Trailer System

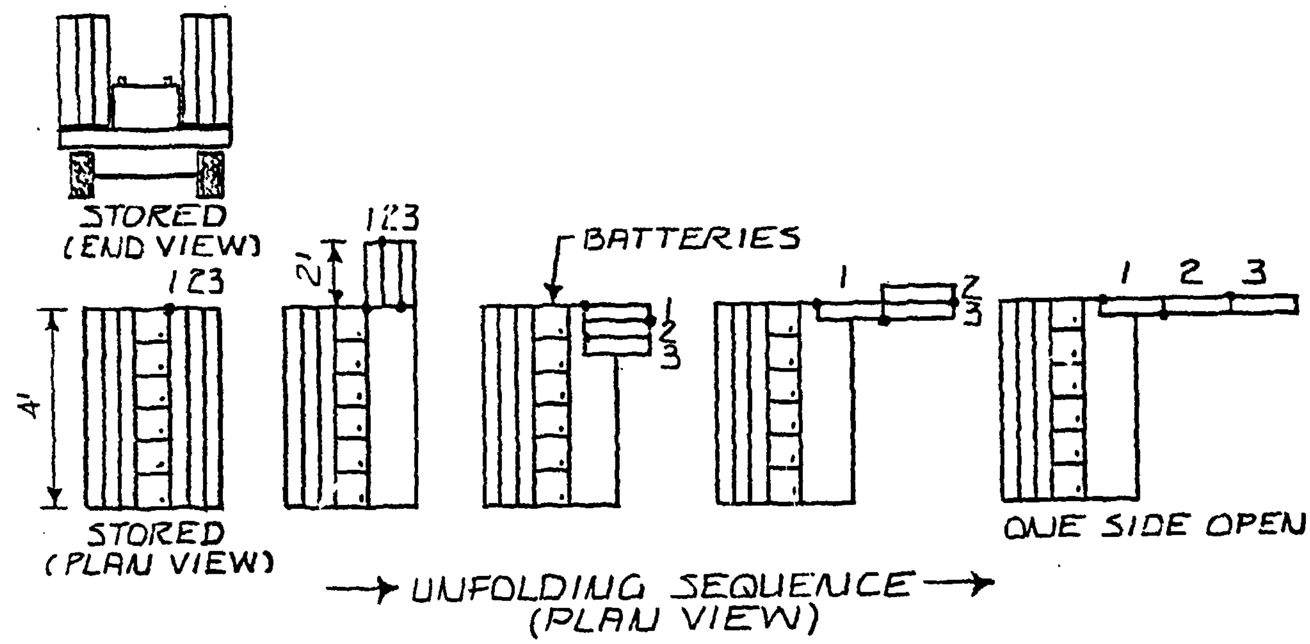


Figure 4-2. Unfolding Sequence for PV Panels for Small Trailer System

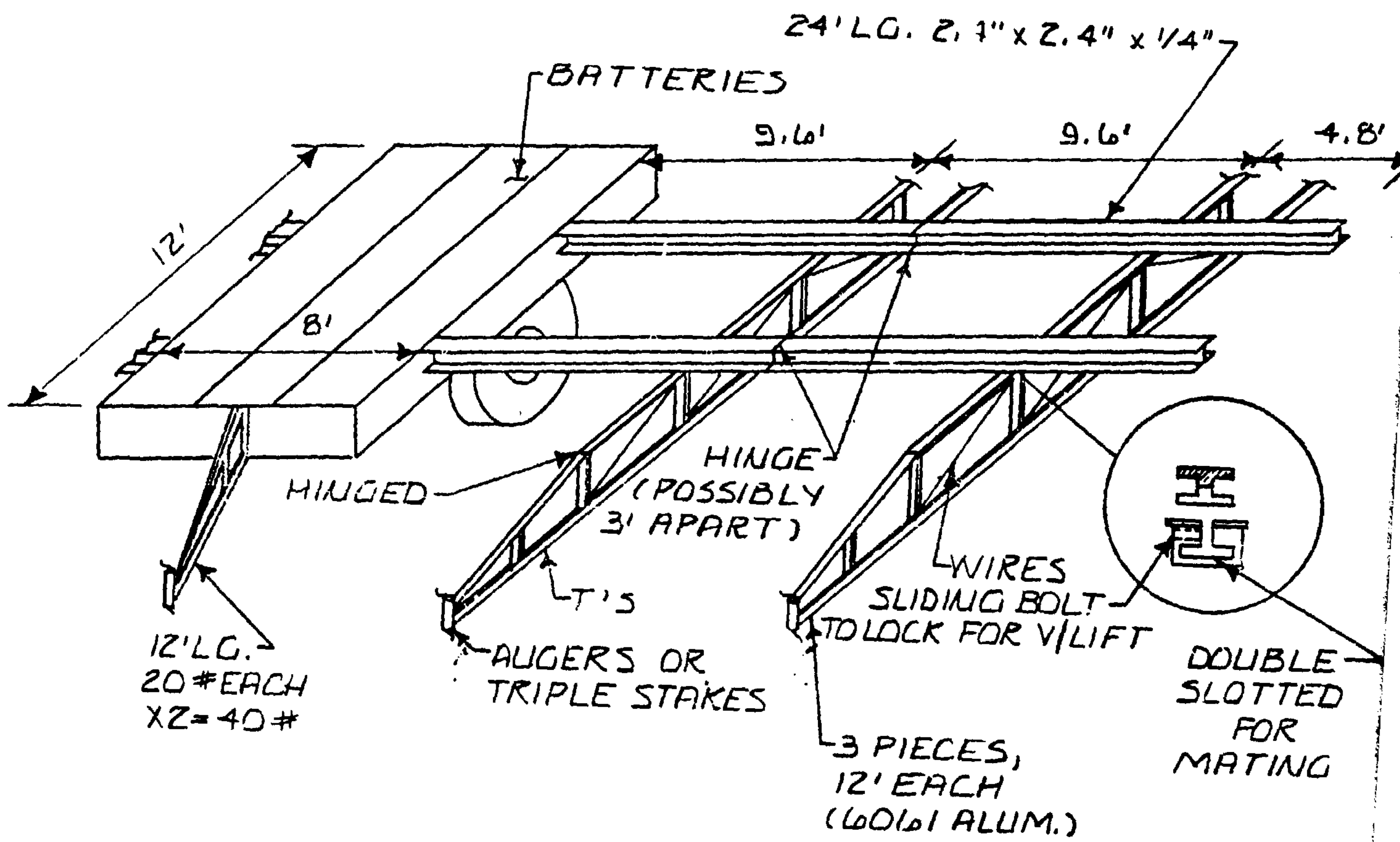


Figure 4-3 Structural support for PV Array on Large Trailer

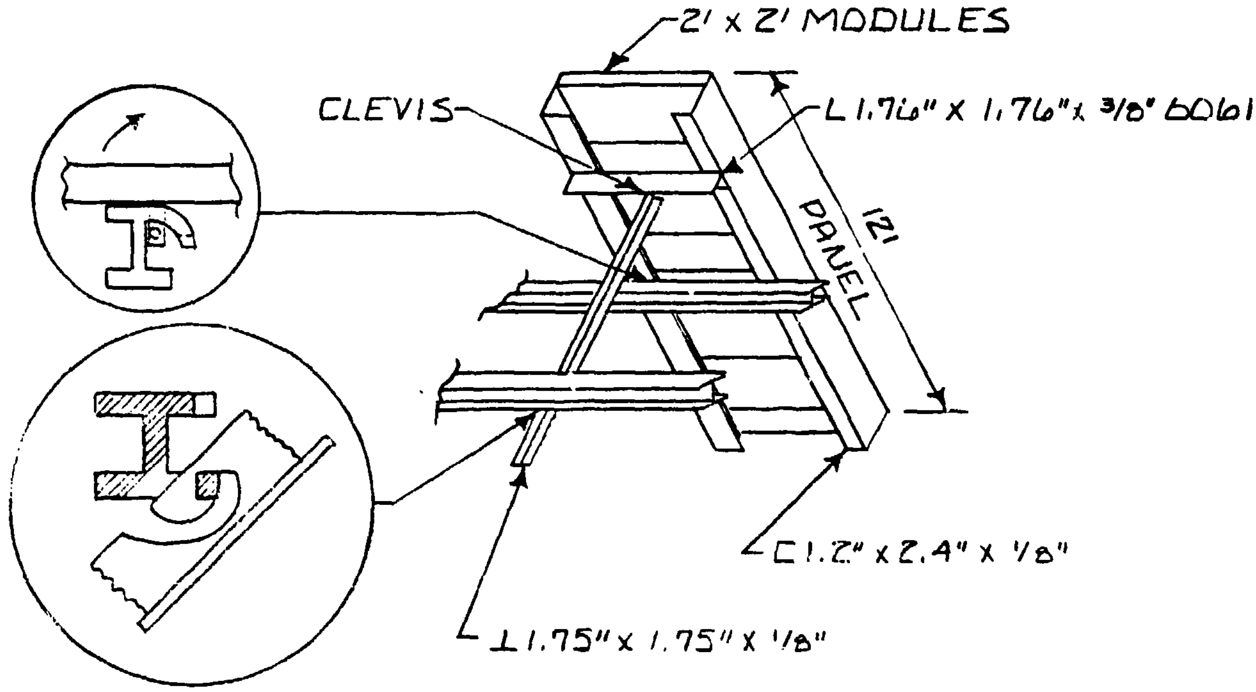


Figure 4-4 Structural Support for Each Panel on Large Trailer

In the next sub-section entitled Methodology, we present some of the background for the final design selections in the way they were arrived at. Based on this methodology the final designs were selected and are described in the final sub-section.

Methodology

The recommended conceptual designs were developed in five steps:

1. the requirements were defined;

2. three independent designers developed concepts;

3. the concepts were evaluated in terms of their suitability in meeting the requirements;

4. the most suitable designs were evaluated in terms of the stresses, sizes of structural members and resistance to overturning; and

5. weights and costs were estimated.

These requirements were developed in a meeting with MERADCOM, held November 24, 1980.

The system was to be erectable within two hours by two men. Disassembly and storing was also to take no more than two hours by two men for the large trailer. Few separate parts were to be used to minimize the risk of loss and the larger trailer was to be no more than 12 feet long, so it would be maneuverable at forward battlefront sites. It was understood that the utility of the transportable systems would be limited by the amount of storage that could be placed on the trailer, but one-day storage was deemed acceptable in many cases. However, the longer the storage, the better the system. The design was to be carried through the conceptual design stage with the intention that the end product should illustrate potential military applications.

The system might be erected for one day or for many days or weeks. It would not be used if the wind velocity exceeded 60 knots, so designs could be based on storing the system during high winds. Erection and storing would be done manually. It was anticipated that the trailer would be towed over all types of terrain, so sufficient ground clearance must be maintained. Cost was not to be a major factor, of greater importance is that the user be confident in the operation of the system.

The systems were to range from a size appropriate for a trailer towable by an M 141 truck to one size to fit into a trailer normally towed behind a 2.5 ton army truck. The trailer need not be the standard trailer; even the towing vehicle could be a special vehicle if this departure offered a significant advantage.

Further, it was concluded that the trailer would always carry the full complement of components. Individual users would not unload batteries or panels in an effort to save weight, at the risk of being short on power. Therefore attention was devoted to providing the maximum power that could be delivered by each of the two trailer systems. It was estimated that, for a four foot by four foot trailer, a five square meter array would be reasonable, although the trailer might hold somewhat more. The largest array that could be carried on an eight foot by twelve foot trailer with a small battery pack would be approximately 60 square meters, allowing a two foot by twelve foot plan area for batteries and power conditioners.

The independent results of the three designers preliminary concepts are shown in Figures 4-5 through 4-13.

Tradeoffs among the various concepts were performed qualitatively, as illustrated in Figure 4-14. Although perfect distinction between designs is not possible because each design shares some similarity with others, the differences are sufficiently clear to permit the comparison of Figure 4-14, from which the recommended design was chosen.

The stresses, deflections and overturning resistances were computed by conventional means. The pressure coefficient for the trailer-mounted array is taken to be approximately 3.0, whether the wind is from the front or from the back. Previously, pressure coefficients of 2.0 or less were recommended. For the 60-knot wind, the wind forces will be 44.6 psf. The sizes of the members shown in Figures 4-1 and 4-3 illustrating the recommended design, are based on this wind force.

Once the member sizes had been determined by the allowable stresses and overturning resistances, the weight was readily calculated. The cost was estimated by obtaining a verbal quote for extruded 6061 aluminum and using this cost

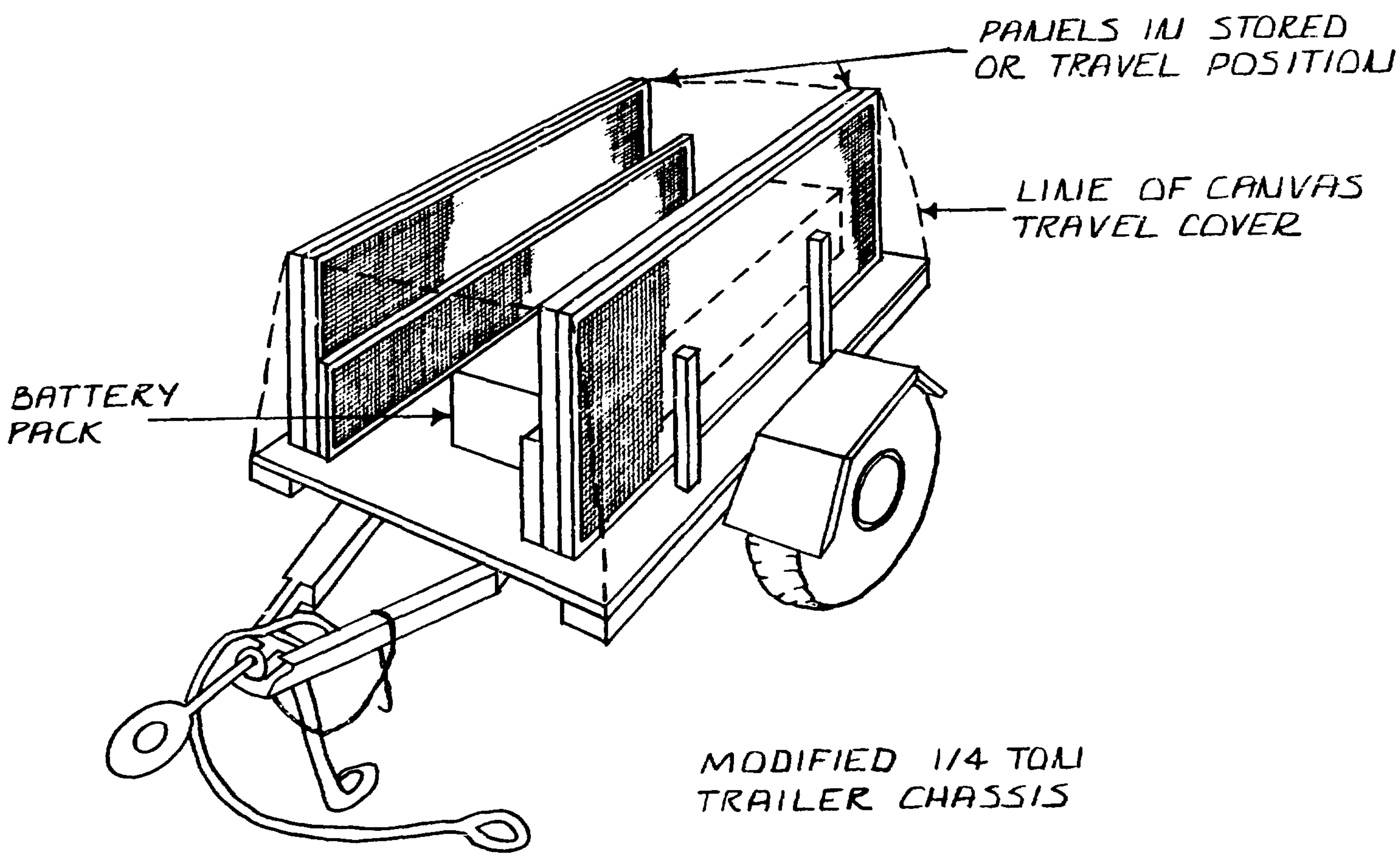


Figure 4-5. Small Trailer System - Panels Folded (Design #1)

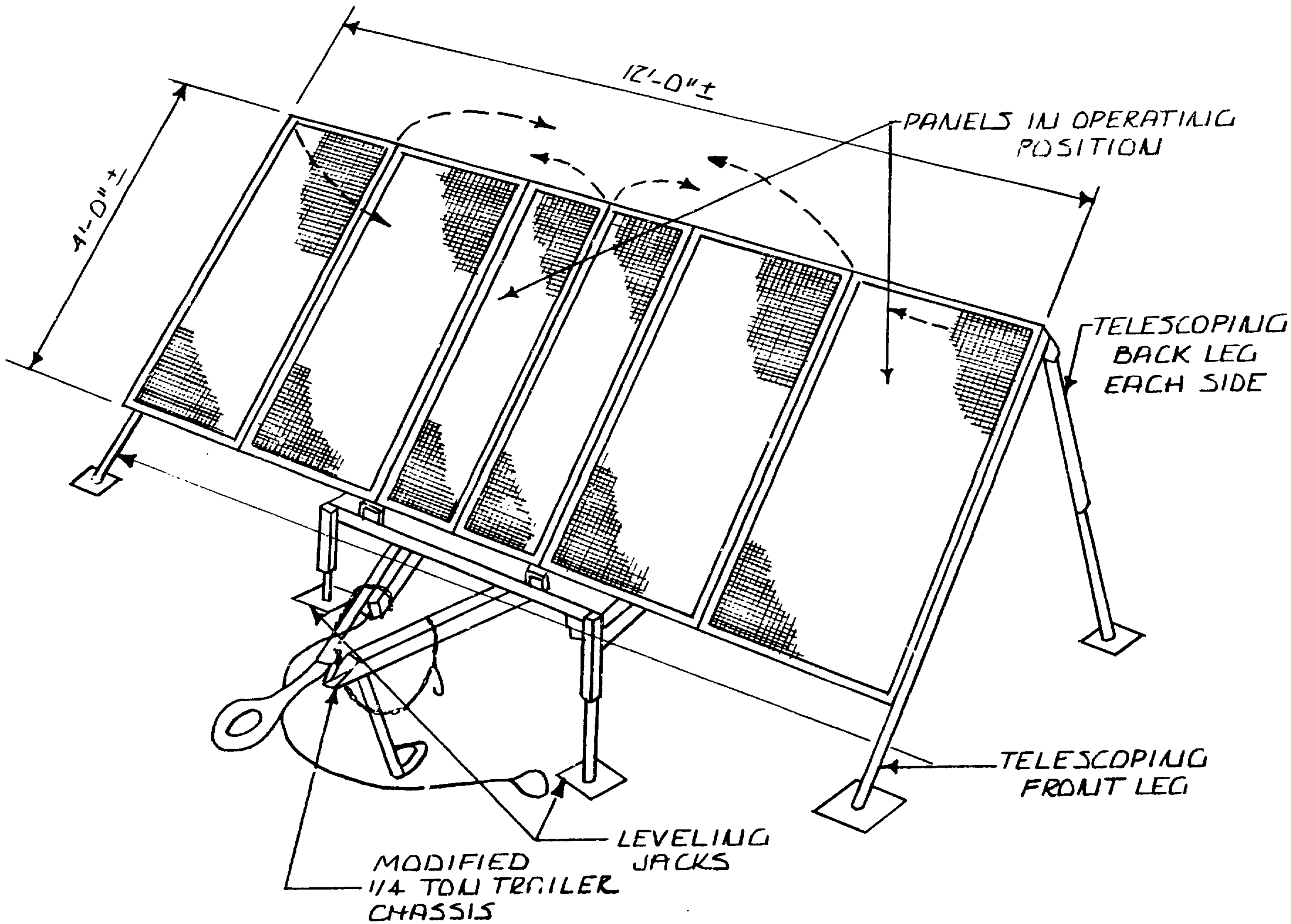


Figure 4-6. Small Trailer - Panels Deployed (Design #1)

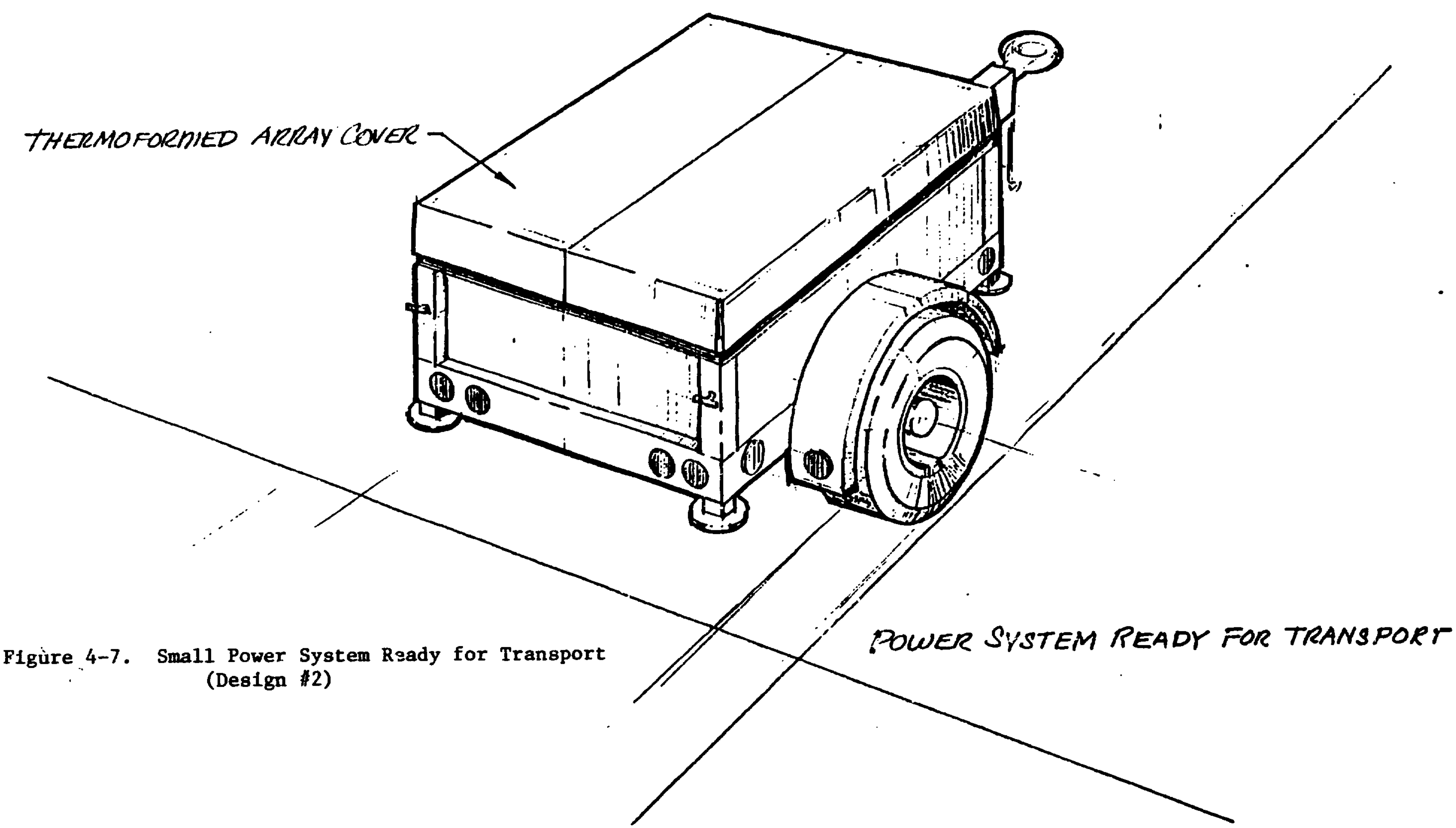


Figure 4-7. Small Power System Ready for Transport
(Design #2)

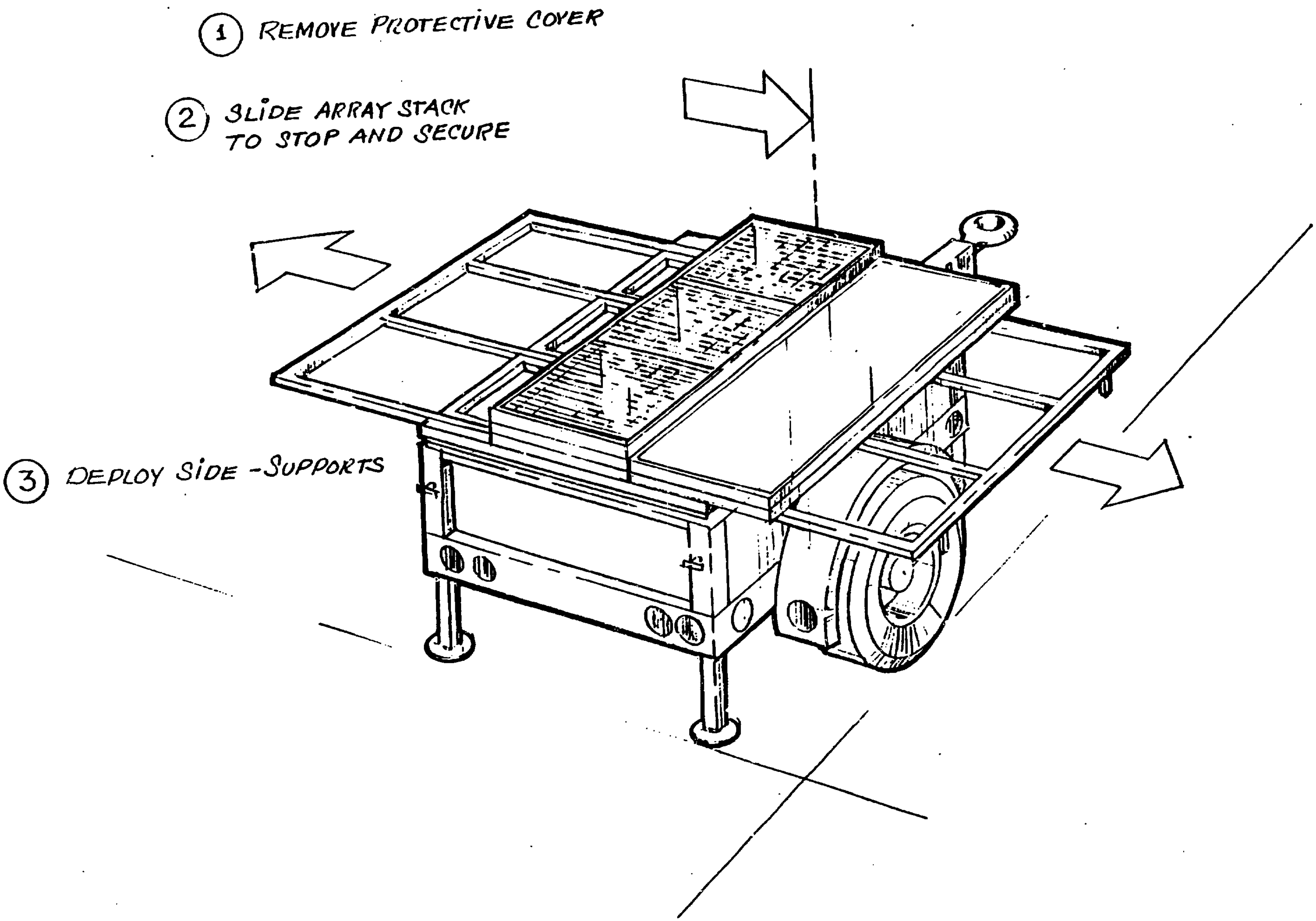


Figure 4-8. Small Power System Partially Deployed (Design # 2)

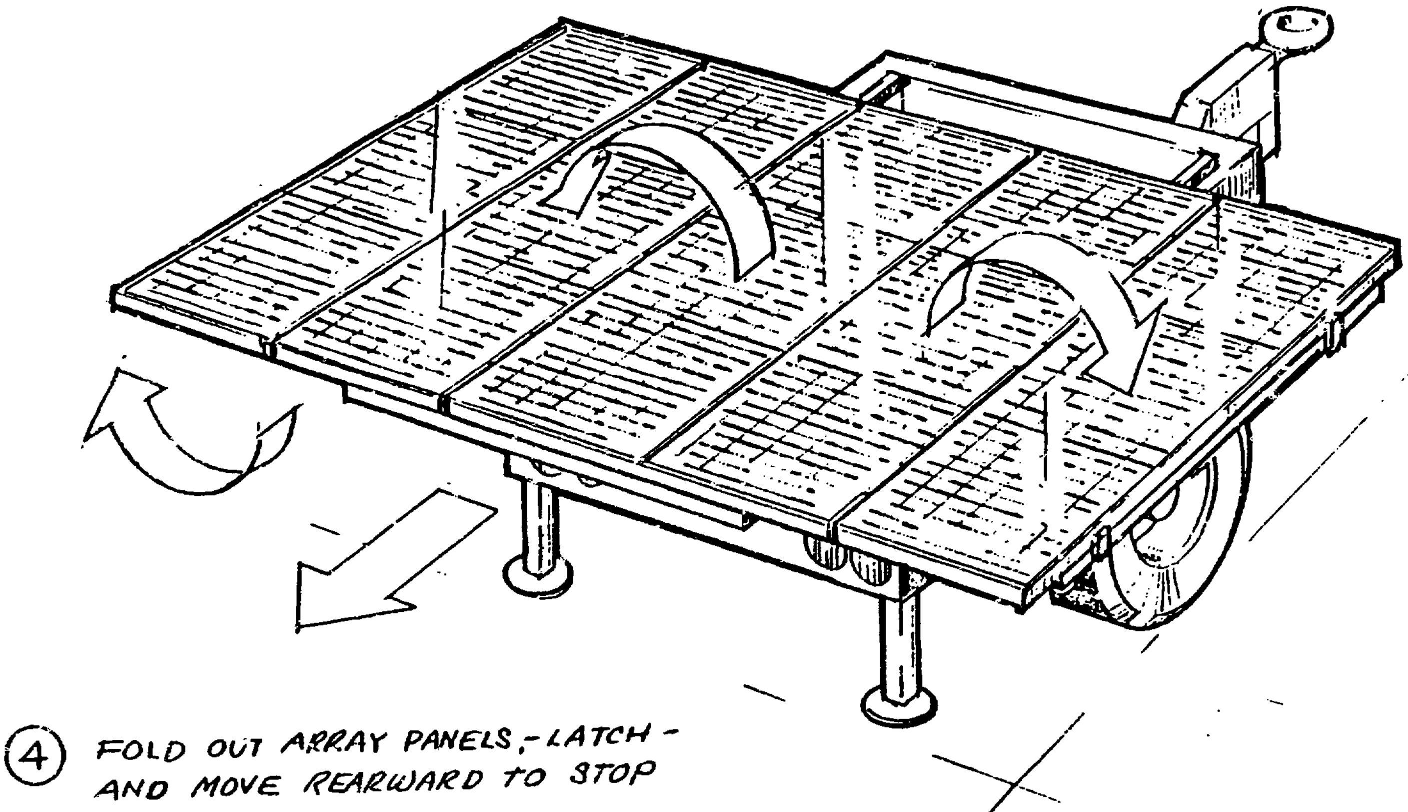


Figure 4-9. Small Power System Further Deployed (Design #2)

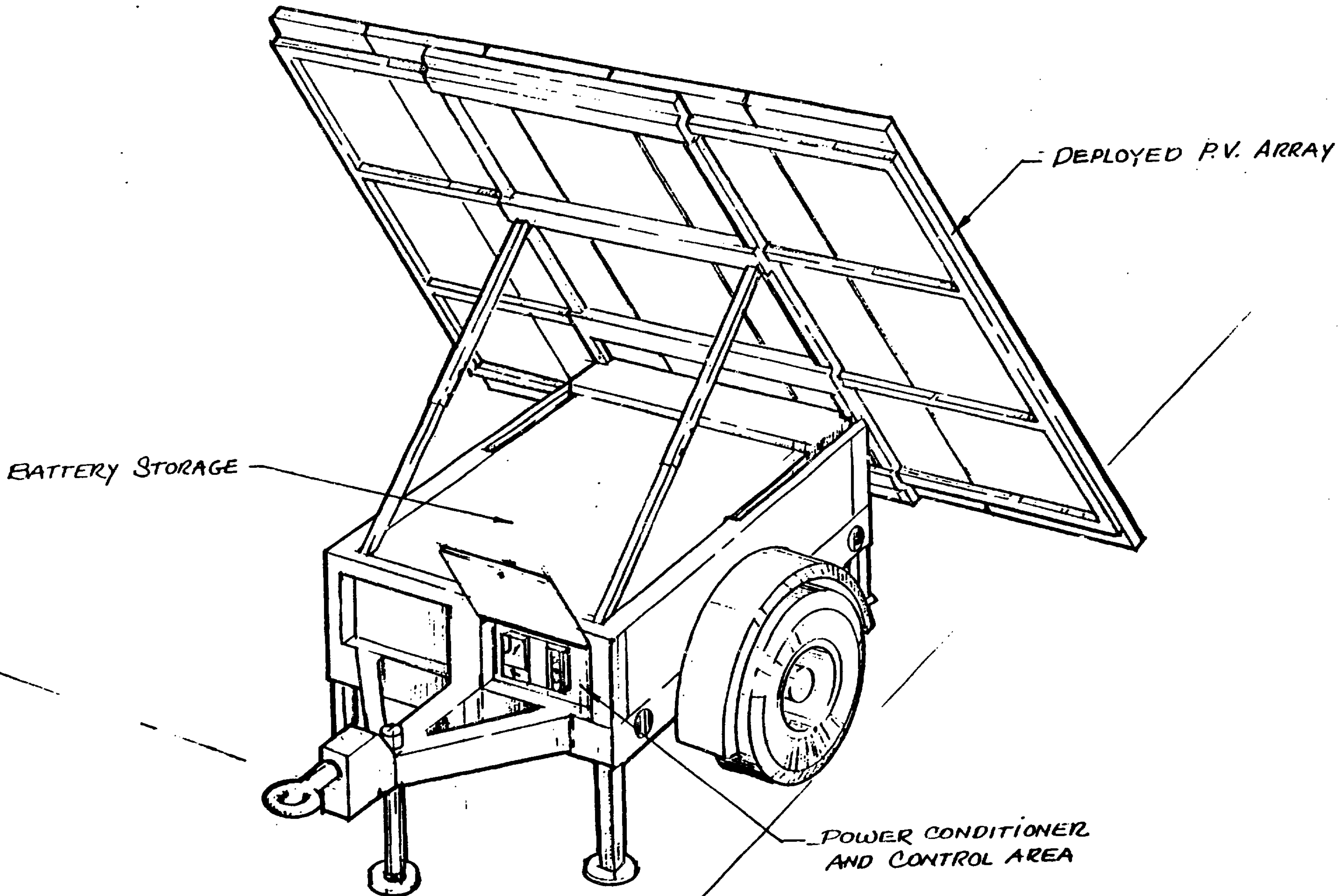


Figure 4-10. Small Power System Fully Deployed (Design #2)

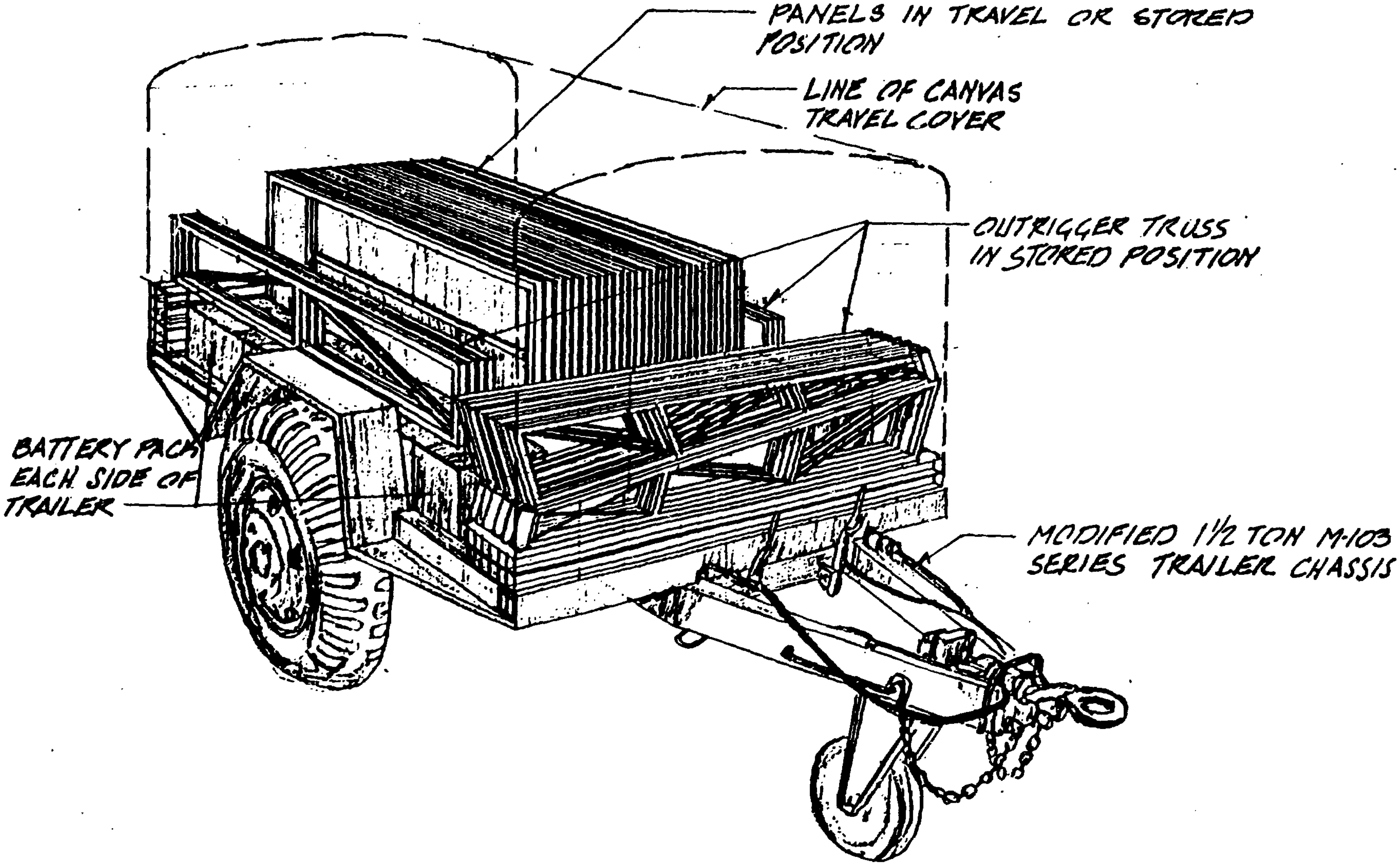


Figure 4-11. Large Power System - Folded (Design #3)

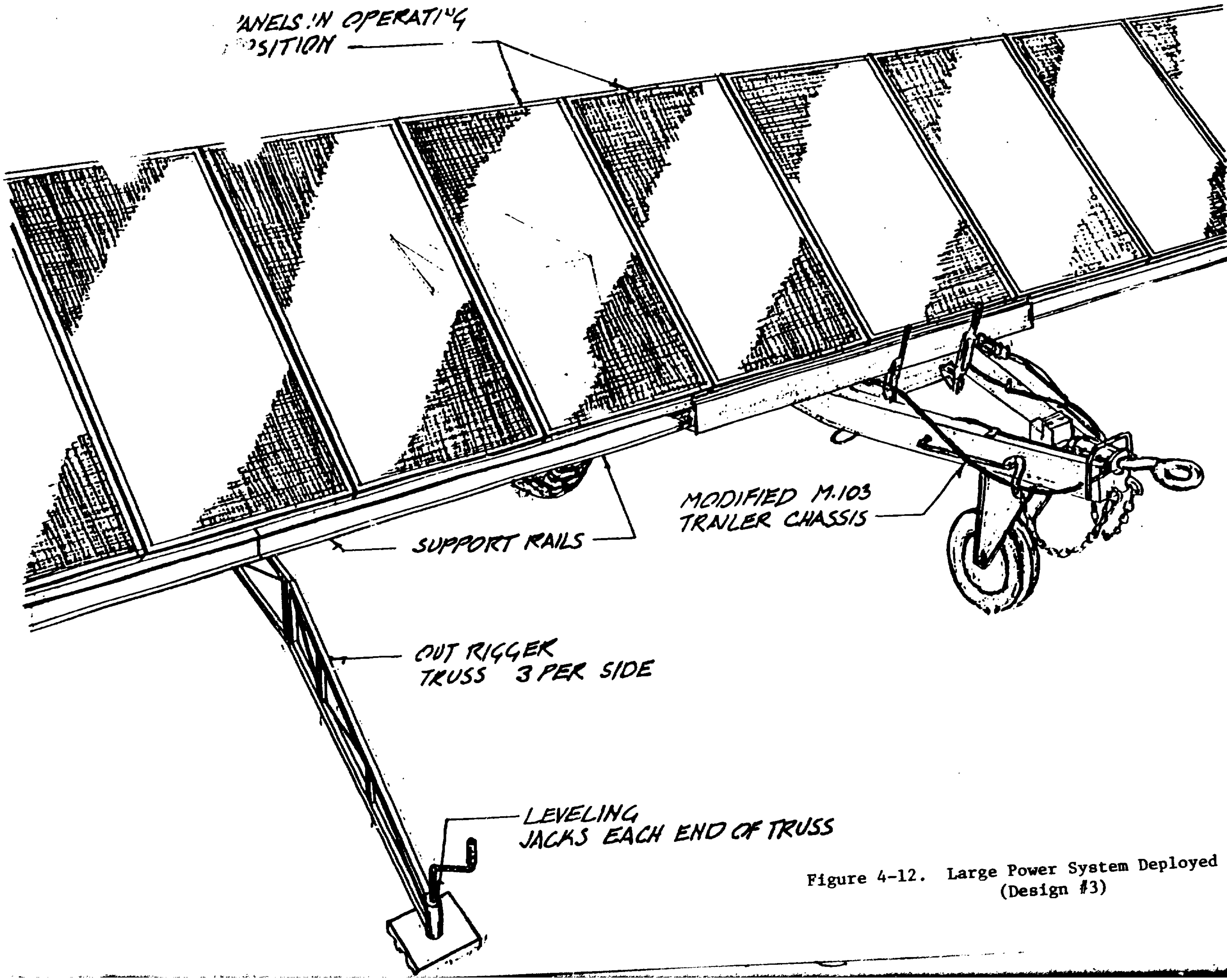


Figure 4-12. Large Power System Deployed
(Design #3)

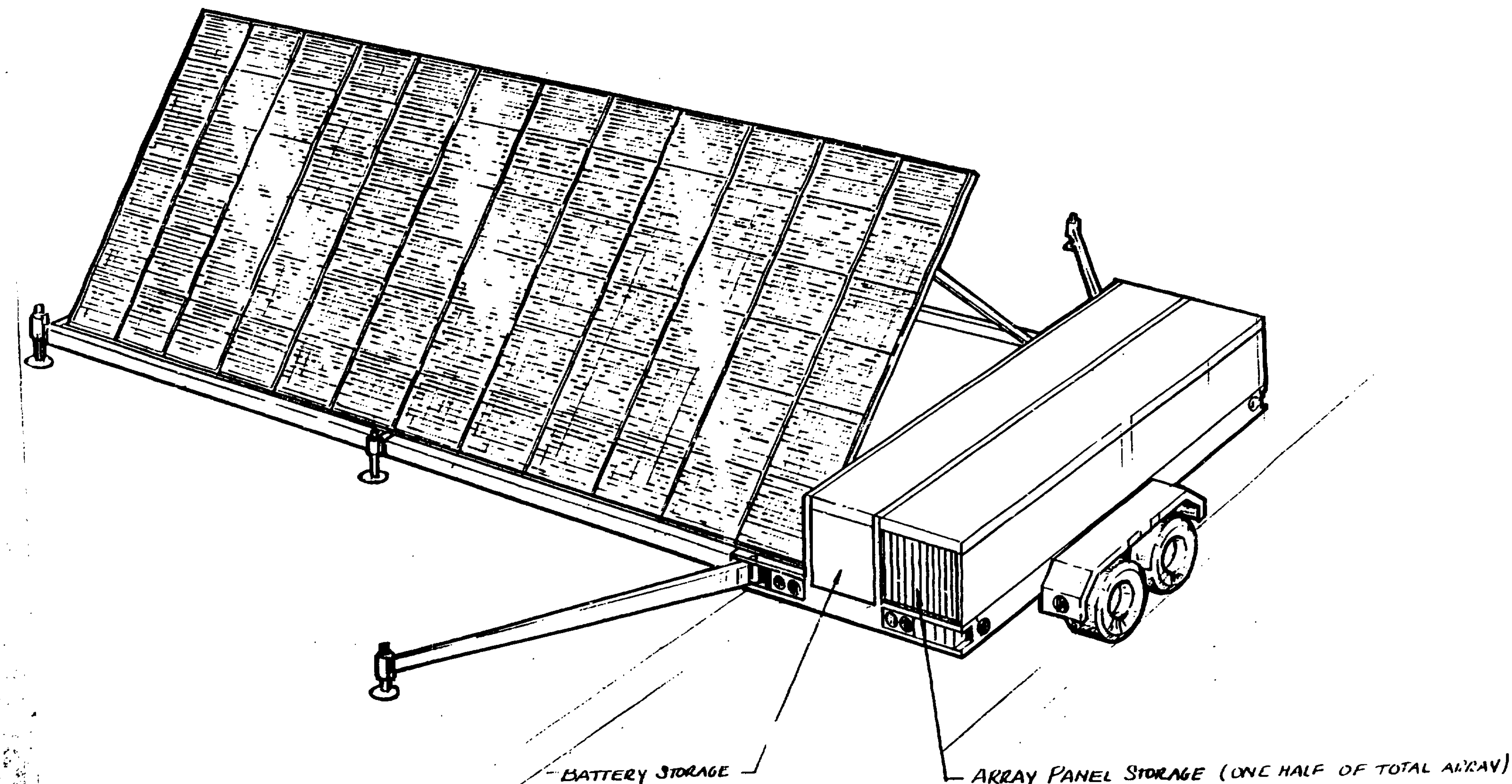


Figure 4-13. Large Power System - Deployed (Optional Design #3)

Figure 4-14

Ranking of Various Design Concepts

	Figure No. (Small Trailer) 4-1	4-5&6	4-7/10	Figure No. (Large Trailer) 4-3	4-11&12	4-13
Transportable	1	1	1	1	1	1
Tiltability	1	1	1	1	1	1
Foldable	1	1	1	2	3	2
Withstand Environments	1	1	1	1	1	1
Separable to aid camoflaging	1	1	1	2	2	2
Light Weight	1	2	1	1	4	3
Compact When Folded	1	1	1	1	1	1
Withstand Field Handling	1	1	1	1	1	1
Low Cost	1	1	1	1	1	1
Comment	C	B	A	F	D	E
Overall	1	2	3	1	3	2

Note: Ranking based on rating of 1 to 4 with 1 being the highest.

Comments:

A. Structure not integrated with module. Telescoping arms can bind.

B. Telescoping arms can bind. Stakes to ground.

C. Can be rotated after erection.

D. Many separate parts. Wide array (8' x 72' versus 12' x 48'). More outriggers.

E. Greater force to raise panel. Sliding arms can bind. Position of toe rail results in heavier panel side channel, but many features of this design would be incorporated into the final design.

F. Few parts, all large.

per pound to estimate the total structure cost. 6061 aluminum was selected because it can be most easily welded and extruded. Higher-strength aluminums, such as 2024 and 7075, are available at somewhat higher costs and are considerably more difficult to fabricate. However, if the design is to be pursued toward construction some of the alternate materials should be more closely evaluated. Their use could reduce the structure weight by 50 percent and hence improve photovoltaic performance by allowing larger total array and battery capacity.

The structure for the battery housing was also analyzed and the trailer beds were found to provide sufficient support when constructed of channels and solid flooring. Therefore, no additional work was necessary in this regard. A fiber-glass-reinforced plastic cover would be placed over the batteries for protection from the weather as well as for safety.

Finally, two designs were distilled from the range of features advanced in the preliminary conceptual design phase. Their descriptions and some details regarding their operation follow.

Description of the Recommended Designs

1. **Small Trailer Size Transportable PV System**

This smaller system is designed to carry a 5 m^2 array (Figure 4-5) and be towable by an M 141 truck when the system is stored.

The smaller trailer would have the batteries located down the center line of the trailer with the photovoltaic modules stored on edge, on both sides of the batteries, extending four feet front to back and two feet high in the stored position. A canvas or fiberglass cover protects the equipment from the weather. The batteries are accessible from the ends of the trailer even when the panels are stored or, for easier access, one of the photovoltaic panels may be swung away.

The modules are each two feet by four feet, with the two-foot edge resting horizontally when erected.

To erect the array, one of the two 120-pound panels containing three modules is tilted upward, while still folded, pivoting on a hinge attached to the trailer bed. The folded array is then rotated around a vertical axis so the first module is facing the sun. Hinges between the modules then permit unfolding of the panel with its four-foot edge still vertical so that all three modules face the sun. Bars are rotated, to lock the modules and prevent rotation around the hinges after erection. Three back braces are attached to the structural channels at the rear of the modules with a rotating key in order to lock the brace and the panel structure together. While one man holds the array, tilting it slowly to the optimal angle, the other attaches the braces to an eye on the trailer. The maximum force that need be extended by each man would be 65 lbs.

Jacks are then extended from the four corners of the trailer to stabilize the system. The jacks are staked into the ground with two or three stakes, depending on the wind speed and the stiffness of the soil. By driving the stakes at an angle of 45 degrees from the vertical, approximately 1,000 pounds withdrawal force can be achieved at each jack. For 60-knot winds, additional staking is required at the tongue. However, no staking at all is required at winds below approximately 30 knots.

One note of interest is that the small sized array can deliver perhaps twice as much power per square foot as a larger array if the vehicle is manually rotated to more directly face the sun throughout the day. Only four rotations would be required daily and the structure has been designed so that all of the supports are on the trailer to facilitate rotation. Since staking of the jacks is only required in high winds, re-orientation is not difficult under most operating circumstances.

2. Large Trailer Size Photovoltaic Transportable Systems

In spite of its much larger size, the 60-square meter (36' long by 12' high) array designed for towing by the 2.5-ton army truck is designed for erection by two men in less than two hours.

The photovoltaic panels are stored on edge along the 12 foot length of the trailer rising only two feet high. As in the small trailer, the batteries are located along the centerline. The batteries in this case, however, are accessible from a walkway between the panels and the batteries. In addition, one set of 12 panels may be removed for easier access. A canvas or fiberglass cover protects the power system.

The array erection process begins with two men installing the supporting structure. First, two 18 foot rails are extended from each side. These rotate or telescope into position. Two open-web trusses per side are next installed by latching them to the rails and staking them to the ground. On windless days, only two stakes are required but in 60-knot winds six stakes are required per truss. The men then each grab one end of a 12 foot by 2 foot 125-pound panel and carry it into a horizontal position on the rails. When in position, the panel is slid toward the rear of the rail and catches in a keyway. After all of the panels are resting on the rails, the men go to the north side, where each man lifts one panel, grabs the rear support rod and push the rod until the panel is at the desired tilt. The rod is then inserted into an eye on the north rail and becomes part of the structure. The installation is complete once the panels are all at the desired tilt. No bolts or pins are required.

The structure was designed to be fabricated from 6061 aluminum, which costs approximately $2.50 per pound in small lots for extrusions. Therefore the cost of the structure as designed is approximately $5.00 per square foot of array or 50¢/watt. If 2024 aluminum were used instead, the cost would be higher on a weight basis due both to higher material costs and higher fabrication cost. On the other hand the weight could be reduced by as much as 30 to 50 percent. Since the total weight of the 6061 system is 860 pounds, this would result in as little as 430 pounds for the 2024 structure. The same structural/mechanical concept could be used with the small trailer to increase the array size to 13 square meters.

SECTION 5

LIFE-CYCLE COST ANALYSIS

5.1 Methodology

At the core of the analysis presented in this section is the concept of the life-cycle cost of a system (LCC), defined as "the present value, as of a specified time period, of all the cash outflows required for constructing and operating (inclusive of maintenance) a system over its lifetime." The categories employed in this analysis are: 1) Operations and Maintenance Costs (O & M), which include expenditures for labor and materials required for supervision, operation, and maintenance (exclusive of major capital replacement; and 2) Capital Costs (CI), which include expenditures for equipment, labor and materials required for construction and major capital replacement. "Nonroutine", or major maintenance is treated as capital replacement and included under capital costs.

Table 5-1 presents a cost breakdown of the components used in this life-cycle analysis. The following determinants were used to compute these costs:

1. The array cost per peak watt output is based on projected cost reduction goals by the Department of Energy for the production of photovoltaic arrays. It assumes peak insolation of 1,000 w/m^2 at 10 percent collector efficiency, with a result of 100 Wp/m^2.

2. The array structure, as indicated in Section 4, will be built entirely out of aluminum. The cost is based on the use of two pounds of aluminum for each square foot of array, with a cost of $2.50 per pound.

3. The trailer costs are based on detailed estimates supplied by a trailer manufacturer. The trailer costs are for customized equipment conforming to all applicable standards, and thus may be higher than could be expected for modification of existing designs or large-scale production.

4. The battery costs are based on a survey of current battery costs. These costs assume the utilization of high-quality lead-calcium batteries, with a 50 percent rate of discharge, and a useful lifetime of ten years. Based on industry projections and current research in battery materials, a price reduc-

tion is projected during the late 1980's. All battery replacements are assumed to be at this lower price.

5. Power conditioning costs are based on a survey of equipment manufacturers. The declining cost estimates are projected to result from standardization, and technological development. This cost estimate includes the cost of control apparatus and wiring. Replacement costs are assumed to be at $0.20/Wp. Equipment lifetime, based on manufacturer's estimates is ten years.

6. O & M costs are based on computer cost runs and actual operating data. Installation costs are included in these estimates.

7. In accordance with federal guidelines for equipment purchases, the discount rate used in this analysis is ten percent. Based on short run inflation rate projections by several private forecasting firms, and long-run projections by federal agencies, the inflation rate used was seven percent. The O & M present value multiplier was determined from these parameters.

Table 5-1

Component Cost Breakdown

Component	(1)	(2)	(3)	(4)	(5)
Array	\$15/Wp	\$10/Wp	\$5/Wp	\$2/Wp	\$1/Wp
2 lb/ft^2 aluminum \$10/ft^2 Array Structure (10.76 ft^2/m^2)	.54/watt	.54/watt	.54/watt	.54/watt	.54/watt
Trailer a) b)	12,590 6,295	12,590 6,295	12,590 6,295	12,590 6,295	12,590 6,295
Battery (50% discharge: 2 x Wp) \$75/kWh	\$150/kWh	\$150/kWh	\$150/kWh	\$75/kWh	
Power Conditioner	0.5/Wp 0.20/Wp	0.4/Wp	0.35/Wp	0.20/Wp	
O & M (pv)*	1% array + 1% structure conditioner	15.15 x	trailer + 2% batteries + 3% power		

CRF = .1174596

(Mg) CI $\left(\frac{1 + g}{1 + k}\right)^j$

*Assumes k = 10%, g = 7%, system lifetime 20 years.

Note: DOE Cost Goals - \$/watt	1982	1983	1984	1985	1986
	\$2.80	\$2.30	\$1.75	\$1.25	\$.70

The following calculations were used in the life cycle cost evaluation of the photovoltaic system:

1. The present value of the replacement cost of the batteries and power conditioning was determined by:

$$(1 + g) \left[CI \quad * \quad \left(\frac{1 + g}{1 + k} \right)^{j} \right]$$

2. Capital costs (CI_{pv}) were calculated by using:

$$CI_{pv} = (1 + g)^{P} \sum \left[CI_{t} \left(\frac{1 + g}{1 + k} \right)^{j} \right]$$

3. O & M costs were calculated by using the present value multiplier.

4. The capital recovery factor was calculated by:

$$CRF = \frac{k}{1 - (1+k)^{-n}} = .1174596$$

5. The annualized system cost ($\overline{AC}$) was computed by:

$$\overline{AC} = (1+g)^{-d} \left\{ CRF \left[(O \,\&\, M)_{pv} + CI_{pv} \right] \right\} = 0.12568 \left[(O\&M)_{pv} + CI_{pv} \right]$$

6. The annual energy output of the photovoltaic system was determined as:

$$E_{A} = (\%\ Duty)(Load)(Availability) \times \left(\frac{24\ hr}{day}\right) \left(\frac{365\ days}{year}\right)$$

7. The levelized energy cost was determined by using:

$$E_{L} = \frac{\overline{AC}}{E_{A}}$$

where:

Y_p	-	The price year, or the reference year for prices for which the best cost data is available
Y_o	-	The year of first operation for the system
Y_t	-	The year for a particular expenditure.
k	=	The opportunity cost of money
CI_t	=	Capital investment in year 't"
p	=	$Y_o - Y_p$
j	=	$Y_t - Y_o + 1$
d	=	$Y_o - Y_p$
g	=	General rate of inflation
CI_{pv}	=	Present value of capital costs
$O \& M_{pv}$	=	Present value of operation + maintenance cost

5.2 Conclusions

Table 5-2 and 5-3 show the total and annualized system costs for each cost schedule and for each array on the small and large trailers. They indicate that current system costs decrease dramatically over the next several years - thru 1986. For perspective, cost schedule (1) represents current system costs while the component costs reflected in schedule (5) are projected to be reached by 1986. The total cost of the 60 m^2 array decreases from \$137,342 initially, to \$34,089 in schedule (5). Similarly, the cost of the 3.5 m^2 array drops from \$17,108 to \$10,240.

The annualized cost of the 60 m^2 array decreases to \$4,595 from an initial \$17,571. Figure 5-1 illustrates these annualized cost reductions. These calculations may be slightly high due to several factors which will be discussed later.

Tables 5-4 and 5-5 show the total annual energy output of each system, for each of ten selected cities, for loads of 250, 500 and 1,000 watts and duty factors of 25, 50, 75 and 100 percent. Table 5-6 indicates levelized energy costs for 40 m^2 and 60 m^2 arrays. Figures 5-2 (a - d) indicates these costs graphically. It is evident from Table 5-4 that the 5 m^2 array is not reliable for any of the selected locations. Because this array does not provide any significant power on a dependable basis, there appears to be little justification for calculating the energy costs of this system. It should be noted that the duty factors represent the percentage of a time period during which the system is being utilized. Since this is a transportable system, it is highly unlikely that the system would be utilized 100 percent, 75 percent, 50 percent and possibly even 25 percent of the time on an annual basis. While this assumption increases the energy cost for the systems, there is a tradeoff of lower loss of load probabilities on an annual average.

These energy costs are higher than normal for several reasons. First, the energy output measured in Table 5-3 is much lower than maximum potential energy. This results from limitations imposed by the load, duty factor, and storage capacity.

A second reason that these costs may be high results from the assumption of 10 percent collector efficiency. While this estimate is reasonable, if not conservative with current output technology, it is a low estimate for future efficiencies. Industry projections indicate that average efficiencies of 12 percent can be expected in the near term with efficiencies of up to 20 percent within the next decade. Even the two percent

Table 5-2

Annualized System Costs

Small Trailer

Cost Schedule (From Table 5-1)	(1) 5 m^2	(2) 5 m^2	(3) 5 m^2	(4) 5 m^2	(5) 5 m^2
Array	7,500	5,000	2,500	1,000	500
Structure	540	540	540	540	540
Trailer	6,295	6,295	6,295	6,295	6,295
Battery (10 kWh/5 m^2); 12 kWH/3.5 m^2)	1,500	1,500	1,500	750	750
Power Conditioning	250	200	175	100	100
P.C. Replacement_{pv}	79	79	79	79	79
Battery Replacement_{pv}	592	592	592	592	592
$(O \& M)_{pv}$	2,726	2,338	1,948	1,460	1,384
Total $(T)_{pv}$	19,496	16,544	13,629	10,816	10,240
Total (w/o trailer)	12,247	9,295	6,380	3,567	2,991
Annualized System Cost	2,450	2,079	1,713	1,359	1,287
(w/o trailer)	1,539	1,168	802	448	376

Note: All figures are in 1980 dollars.

Table 5-3

Annualized System Costs

Large Trailer

Cost Schedule	(1)		(2)		(3)		(4)		(5)	
(From Table 6-1)	60 m^2	40 m^2	60 m^2	40 m^2	60 m^2	40 m^2	60 m^2	40 m^2	60 m^2	40 m^2
Array	90,000	60,000	60,000	40,000	30,000	20,000	12,000	8,000	6,000	4,000
Structure	6,456	4,304	6,456	4,304	6,456	4,304	6,456	4,304	6,456	4,304
Trailer	12,590	12,590	12,590	12,590	12,590	12,590	12,590	12,590	12,590	12,590
Battery (40 kWh/60 m^2, 70 kWh/40 m^2)	6,00'	10,500	6,000	10,500	6,000	10,500	3,000	5,250	3,000	5,250
Power Conditioner	3,000	2,000	2,400	1,600	2,100	1,400	1,200	888	1,200	800
P.C. Replace$_{pv}$*	947	632	947	632	947	632	947	632	947	632
Battery Replace$_{pv}$	2,368	4,144	2,368	4,144	2,368	4,144	2,368	4,144	2,368	4,144
O & M (15.15 govt. multiplier)	19,212	15,740	14,395	12,528	9,713	9,407	5,668	5,726	4,759	5,120
Total$_{pv}$ (T)	139,811	109,910	104,394	86,298	69,412	62,977	43,467	41,446	36,558	36,840
(w/o trailer)	125,314	95,413	89,897	71,801	54,915	48,480	28,970	26,949	22,061	22,343
Annualized System Cost										
AC = .12568 (T)	17,571	13,813	13,120	10,846	8,724	7,915	5,463	5,209	4,595	4,630
(w/o trailer)	15,749	11,992	11,298	9,024	6,902	6,093	3,641	3,387	2,773	2,808

Note: All figures are 1980 dollars.

Table 5-4
Annual Energy Output (kWh) Location, Duty Factor/Large Trailer*

Location	Load (kW)	25% 40 m²	25% 60 m²	50% 40 m²	50% 60 m²	75% 40 m²	75% 60 m²	100% 40 m²	100% 60 m²
	.250	548	547	1,095	1,095	1,643	1,641	2,096	2,178
Washington,	.500	1,095	1,095	2,190	2,178	—	2,904	—	3,110
D.C.	1.000	2,096	2,190	—	3,220	—	2,539	—	372
	.25	548	548	1,095	1,095	1,642	1,642	2,190	2,190
San Antonio,	.50	1,095	1,095	2,190	2,190	3,249	3,281	—	4,295
Texas	1.0	2,190	2,190	—	4,292	—	4,130	—	2,457
	0.25	502	527	—	970	—	1,178	—	1,340
Juneau,	0.50	—	970	—	1,340	—	1,481	—	1,483
Alaska	1.0	—	1,340	—	1,476	—	78	—	—
	.25	548	547	992	1,067	—	1,379	—	1,567
Cambridge,	.50	992	1,067	—	1,567	—	1,900	—	1,863
U.K.	1.0	—	1,567	—	1,863	—	1,108	—	—
	0.25	548	548	1,095	1,095	1,642	1,642	2,190	2,190
Almeria,	0.50	1,095	1,095	2,190	2,189	3,252	3,282	—	4,318
Spain	1.0	2,190	2,189	—	4,318	—	4,650	—	3,532
	.25	548	548	1,095	1,095	1,642	1,642	2,190	2,190
Albrook AB	.50	1,095	1,095	2,190	2,190	3,278	3,281	—	4,334
Panama	1.0	2,190	2,190	—	4,334	—	3,227	—	590
	.25	548	548	1,095	1,095	1,642	1,642	2,190	2,190
Seoul,	.50	1,095	1,095	2,190	2,190	3,095	3,277	—	4,209
Korea	1.0	2,190	2,190	—	4,209	—	2,935	—	—
	.25	548	548	1,095	1,095	1,642	1,642	2,190	2,190
Jerusalem,	.50	1,095	1,095	2,190	2,190	3,285	3,285	4,354	4,379
Israel	1.0	2,190	2,190	4,354	4,379	—	6,187	—	5,528
	.25	548	548	1,095	1,095	1,643	1,643	2,190	2,190
Honolulu,	.50	1,095	1,095	2,190	2,190	3,285	3,285	3,797	4,374
Hawaii	1.0	2,190	2,190	3,797	4,374	—	5,014	—	2,485
	.25	547	547	1,075	1,090	1,368	1,496	1,822	1,882
Munich,	.50	1,075	1,090	1,822	1,882	—	2,669	—	2,975
W. Germany	1.0	1,822	1,882	—	2,975	—	2,220	—	—

*A blank indicates an average loss of load probability of greater than [illegible]

Table 5-5

Annual Energy Output (kWh) By Location, Duty Factor/Small Trailer*

Location	Load (kW)	25% 3.5 m^2	25% 5 m^2	50% 3.5 m^2	50% 5 m^2	75% 3.5 m^2	75% 5 m^2	100% 3.5 m^2	100% 5 m^2
Washington, D.C.	.125	265	—	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	.500	—	—	—	—	—	—	—	—
San Antonio, Texas	125	274	274	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Juneau, Alaska	125	—	—	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Cambridge, U.K.	125	—	—	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Almeria, Spain	125	274	274	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Albrook AB, Panama	125	274	274	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Seoul, Korea	125	274	273	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Jerusalem, Israel	125	274	274	545	—	—	—	—	—
	250	545	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Honolulu, Hawaii	125	274	274	482	—	—	—	—	—
	250	482	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—
Munich, W. Germany	125	228	—	—	—	—	—	—	—
	250	—	—	—	—	—	—	—	—
	500	—	—	—	—	—	—	—	—

[illegible] load probab ity of greater than 20%.

Table 5-6

Levelized Energy Costs ($) for 40 m^2 and 60 m^2 Arrays

			(1)		(2)		(3)		(4)		(5)	
			25%	75%	25%	75%	25%	75%	25%	75%	25%	75%
San Antonio, Texas*	500	40 m^2	$12.61	$ 5.40	9.90	4.24	7.23	3.09	4.76	2.04	4.23	1.81
		60 m^2	16.05	5.36	11.98	4.00	7.97	2.66	4.99	1.67	4.20	1.40
	1,000	40 m^2	6.30	—	4.95	—	3.61	—	2.38	—	2.11	—
		60 m^2	8.02	4.25	5.99	3.17	3.98	2.11	2.49	1.32	2.10	1.11
Juneau, Alaska	500	40 m^2	—	—	—	—	—	—	—	—	—	—
		60 m^2	18.11	11.86	13.52	8.86	8.99	5.89	5.63	3.67	4.74	3.10
	1,000	40 m^2	—	—	—	—	—	—	—	—	—	—
		60 m^2	13.11	225.26	9.79	168.19	6.51	111.84	4.07	70.03	3.43	58.90
Jerusalem, Israel	500	40 m^2	12.61	4.20	9.90	3.30	7.23	2.41	4.76	1.58	4.23	1.41
		60 m^2	16.05	5.35	11.98	3.99	7.97	2.66	4.99	1.66	4.20	1.40
	1,000	40 m^2	6.31	—	4.95	—	3.62	—	[illegible]	—	2.12	—
		60 m^2	8.02	2.84	5.99	2.12	3.98	1.41	2.49	0.88	2.10	0.74
Munich, W. Germany	500	40 m^2	12.85	—	10.09	—	7.36	—	4.85	—	4.31	—
		60 m^2	16.12	6.58	12.04	4.91	8.00	3.27	5.01	2.05	4.22	1.72
	1,000	40 m^2	7.58	—	5.95	—	4.34	—	2.86	—	2.54	
		60 m^2	9.34	7.91	6.97	5.91	4.64	3.93	2.90	2.46	2.44	2.07

*Energy costs for Washington, D.C. Almeria, Spain, Albrook AB, Panama, Seoul, Korea, Honolulu, Hawaii are similar to these costs.

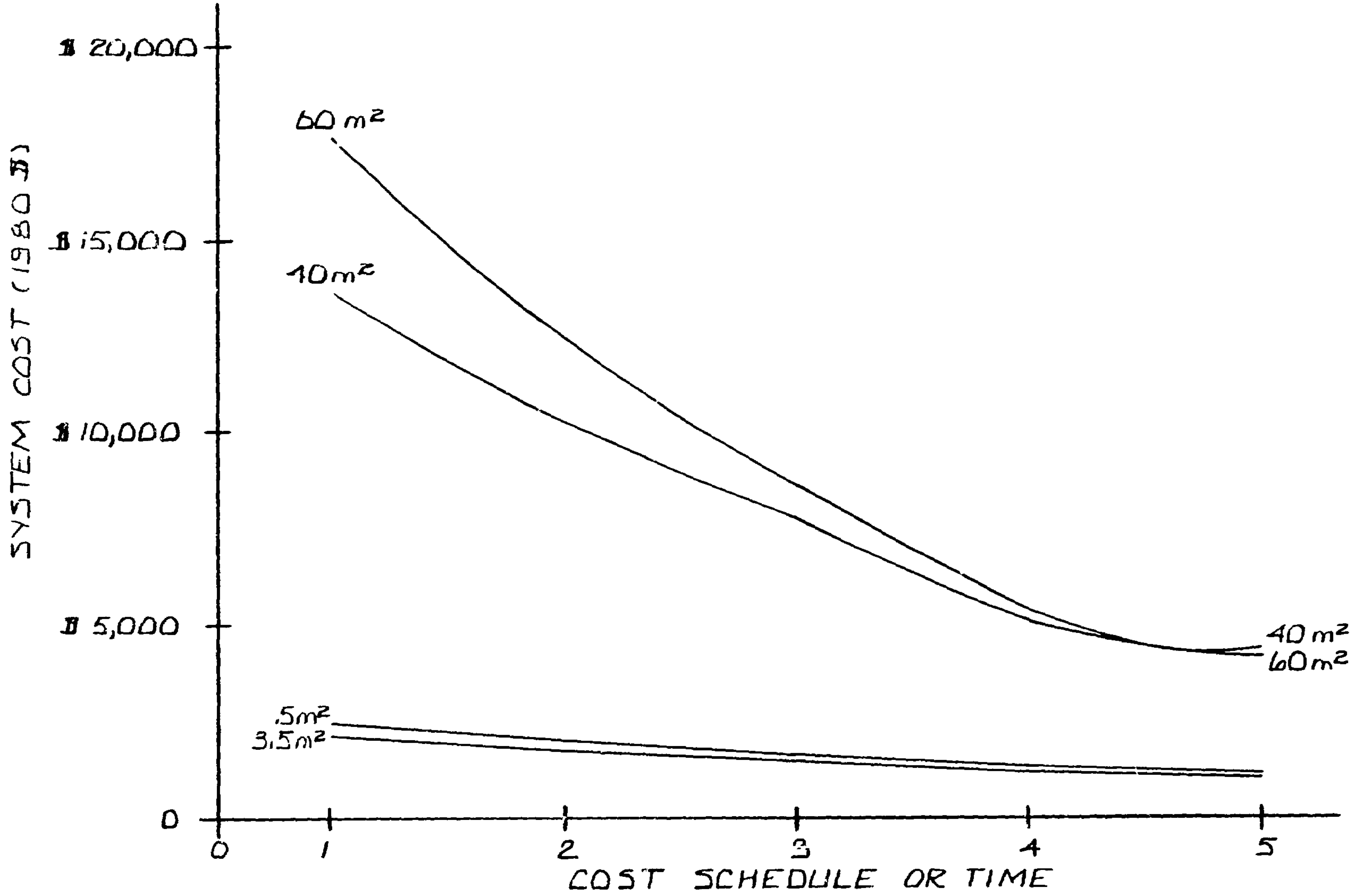


Figure 5-1. ANNUALIZED SYSTEM COST VS. TIME
(TIME IN YEARS)

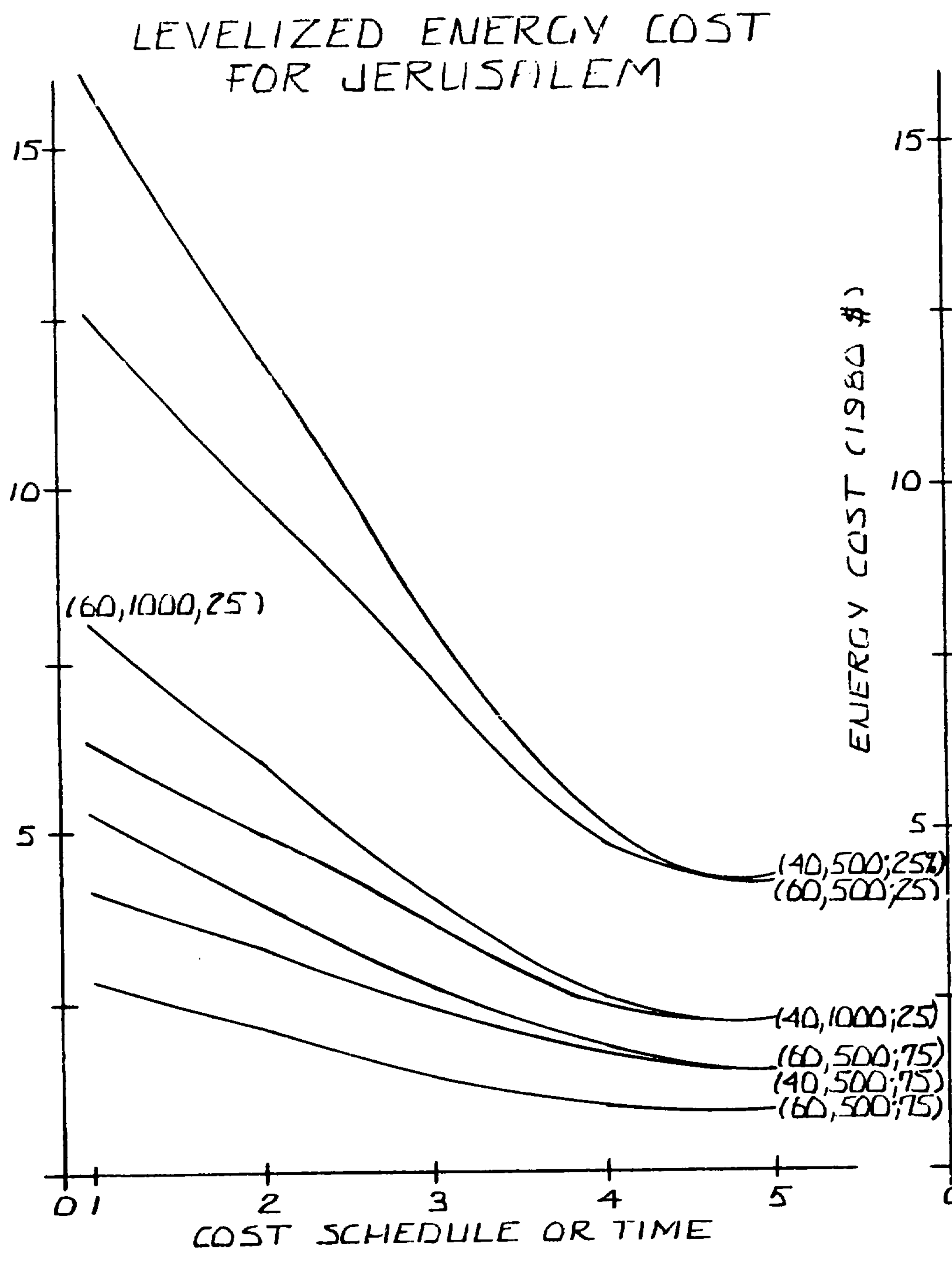


Figure 5-2 (c)

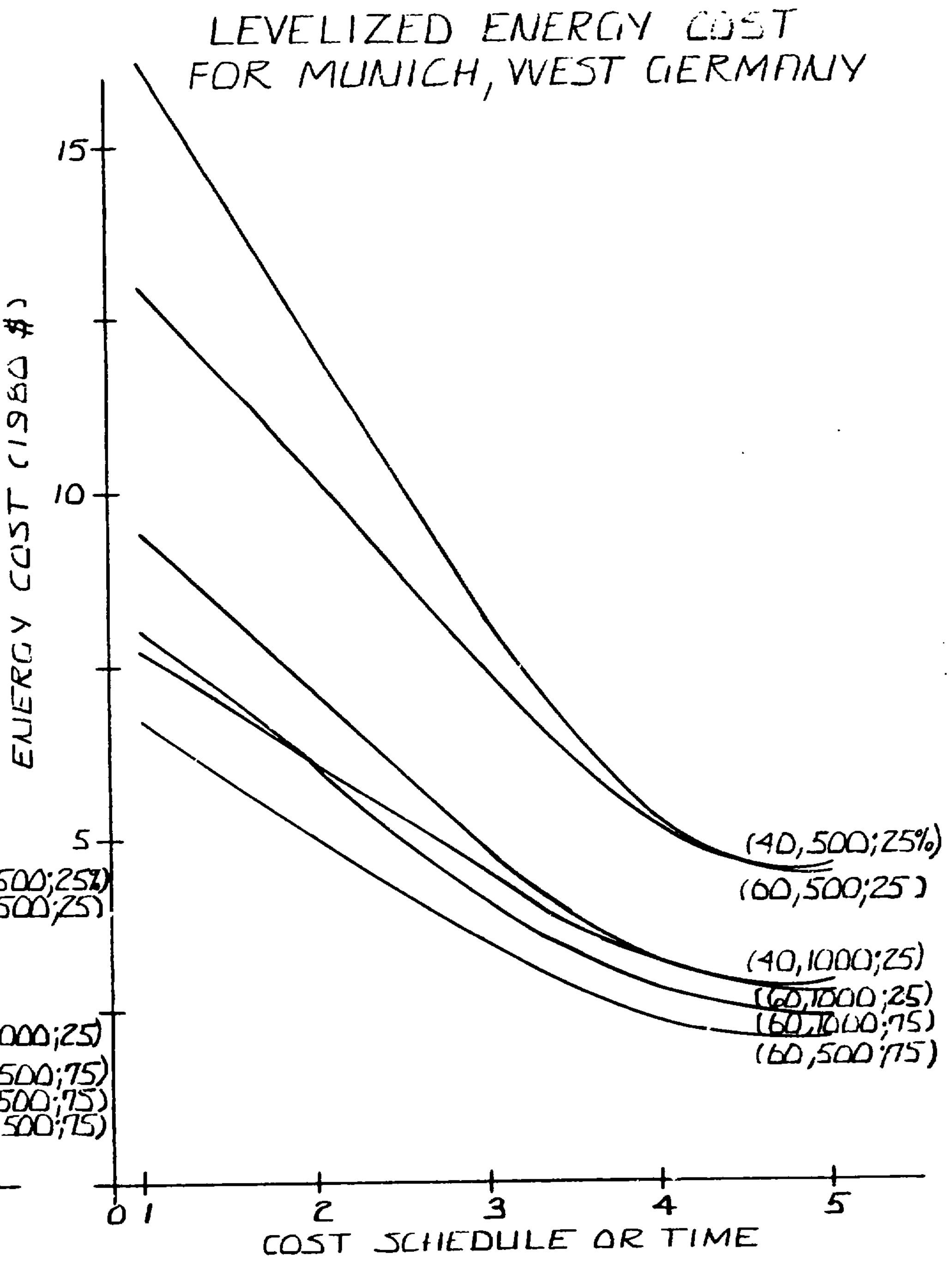


Figure 5-2 (d)

difference from 10 percent to 12 percent would result in a 20 percent increase in projected output; a significant variation.

Third, it is important to note the significant contribution of initial trailer costs and trailer O & M costs to the total and annualized system costs. Because the photovoltaic system is not designed to be removable under normal operating conditions, the cost of the trailer was assumed to be a system cost. But because it is a fixed cost over time, while the costs of the other major components decrease, the trailer cost and O & M costs assume a larger portion of total costs over time. For example, trailer costs for the 60 m^2 array increase from nine percent to 40 percent of total system costs. Table 5-7 shows trailer costs as a proportion of total costs, and presents the annualized system costs with the trailer excluded. Figure 5-3 graphically illustrates the trailer costs as a percentage of total costs.

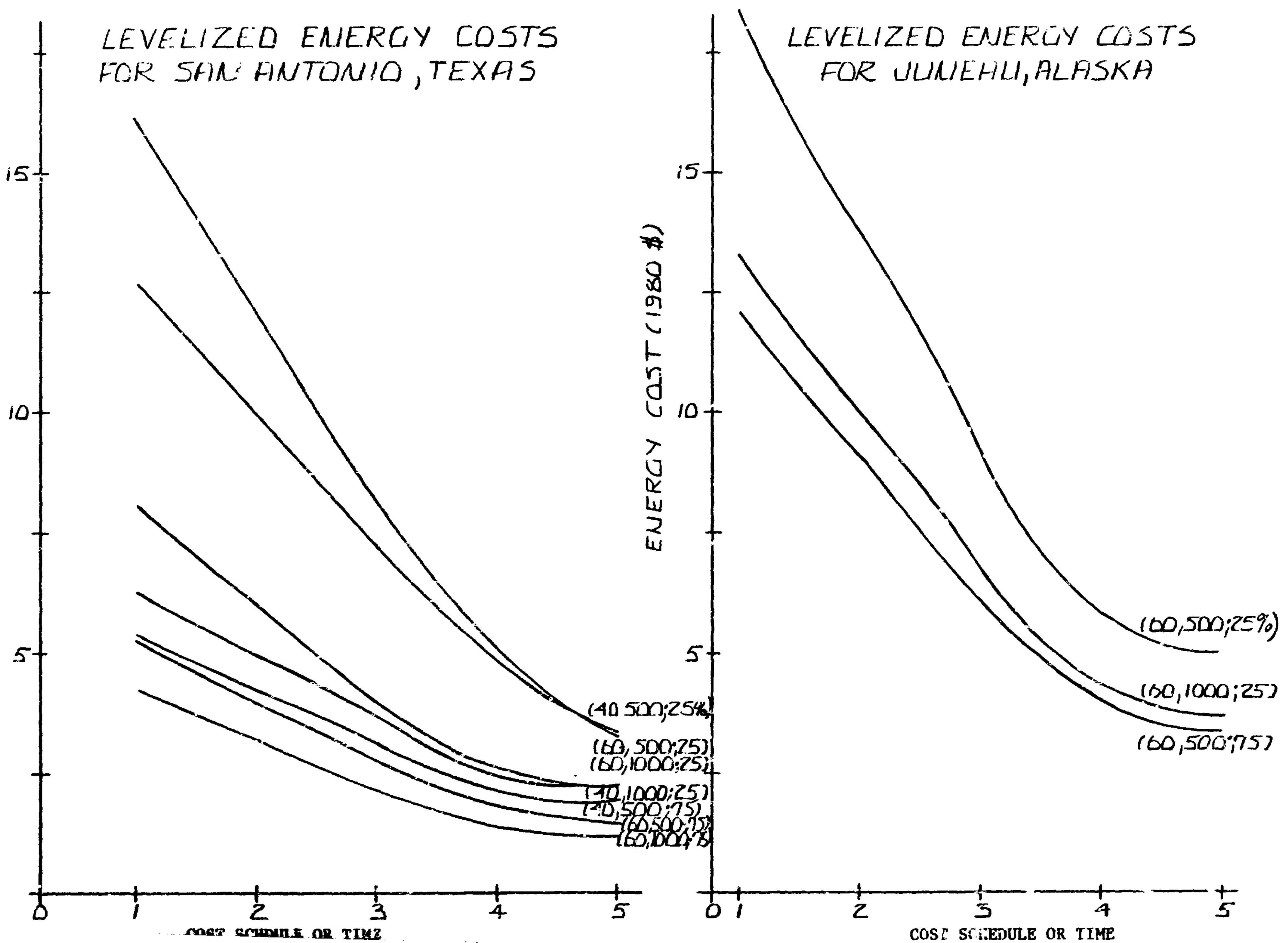
Because the trailer costs are such a large portion of the system cost, especially in later years, the energy cost does not drop as significantly as it would if the trailer were not considered part of the system. Table 5-8 shows the energy cost with and without trailer inclusion in system costs for a selected location on a 500 watt load for a duty factor of 75 percent. Figure 5-4 illustrates the lowering of energy cost which results from trailer exclusion.

Table 5-7

Effect of Trailer Cost on Levelized Energy

Cost for 500 Watt Load at 75% Duty Factor

Cost Schedule Array Size m^2		(1)	(2)	(3)	(4)	(5)
San Antonio						
40	w/trailer	5.40	4.24	3.09	2.04	1.81
	w/o trailer	4.70	3.52	2.38	1.33	1.10
60	w/trailer	5.36	4.00	2.66	1.67	1.40
	w/o trailer	4.88	3.44	2.10	1.12	0.84
Jerusalem						
40	w/trailer	4.20	3.30	2.41	1.50	1.41
	w/o trailer	3.65	2.74	1.86	1.03	0.86
60	w/trailer	5.35	3.99	2.66	1.66	1.40
	w/o trailer	4.87	3.43	2.10	1.11	0.84



LEVELIZED ENERGY COSTS
FOR SAN ANTONIO, TEXAS
LEVELIZED ENERGY COSTS
FOR JUNEAU, ALASKA
ENERGY COST (1980 $)
15
10
5
0
1
2
3
4
5
(40,500;25%)
(60,500;75)
(60,1000;25)
(40,1000;25)
(40,500;75)
(60,500;75)
(60,1000;75)
(60,500;25%)
(60,1000;25)
(60,500;75)
COST SCHEDULE OR TIME
COST SCHEDULE OR TIME

Table 5-7

Comparison of Annualized System Costs

With and Without Trailer Costs

(1980 Dollars)

Cost Schedule Array Size m^2	(1)	(2)	(3)	(4)	(5)
60 m^2					
AC (w/trailer)	17,200	12,749	8,352	5,092	4,223
AC (w/o trailer)	15,378	10,972	6,535	3,270	2,401
Trailer as % Total Costs	9%	13%	19%	32%	38%
40 m^2					
AC (w/trailer)	13,540	10,573	7,642	5,936	4,357
AC (w/o trailer)	11,718	8,750	5,820	3,114	2,535
Trailer as % Total Costs	12%	15%	21%	32%	36%
5 m^2					
AC (w/trailer)	2,416	2,045	1,679	1,325	1,253
AC (w/o trailer)	1,505	1,134	768	414	342
Trailer as % Total Costs	38%	45%	54%	69%	73%
3.5 m^2					
AC (w/trailer)	2,126	1,865	1,609	1,300	1,249
AC (w/o trailer)	1,214	954	698	389	340
Trailer as % Total Costs	43%	49%	57%	70%	73%

Table 5-8

Comparison of Annualized System Costs

With and Without Trailer Costs

Cost Schedule	$15/Wp	$10/Wp	$5/Wp	$2/Wp	$1/Wp
Array Size m^2	(1)	(2)	(3)	(4)	(5)
60 m^2					
AC (w/trailer)	17,571	13,120	8,724	5,463	4,595
AC (w/o trailer)	15,749	11,298	6,902	3,641	2,773
Trailer as % Total Costs	9%	14%	21%	33%	40%
40 m^2					
AC (w/trailer)	13,813	10,846	7,915	5,209	4,630
AC (w/o trailer)	11,992	9,024	6,093	3,387	2,808
Trailer as % Total Costs	13%	17%	23%	35%	39%
5 m^2					
AC (w/trailer)	2,450	2,079	1,713	1,359	1,287
AC (w/o trailer)	1,539	1,168	802	448	376
Trailer as % Total Costs	37%	44%	53%	67%	71%

As a result of these factors, the systems energy costs are substantially greater than if these factors were excluded from the analysis. There is debate as to whether or not these factors should be considered in the overall analysis, but they have been included so as to present the most conservative cost estimates. Their effect should be noted in any cost effectiveness considerations.

From the data presented in this section several broad conclusions concerning the costs for the different systems can be reached:

1. The small trailer arrays, 3.5 and 5 square meter, do not generate sufficient energy or maintain sufficient availability to be economical and reliable power systems.

2. There are several locations (Cambridge, U.K., Juneau, Alaska) where the systems maintain high energy costs throughout the cost reduction schedule. Coupled with high LOLP, in these locations, the solar power system does not appear to be economical or practical power systems.

3. In contrast to the locations mentioned above, a number of locations exhibit reasonable energy

costs, especially with the projected system cost reductions.

4. Overall the smaller array is the least expensive system initially, due to the relative expense of larger arrays size versus larger battery capacity. But as the array cost decreases, the 60 m^2 array becomes more economical than the 40 m^2 array. The trend in cost reductions indicates over the long run the larger array would be less expensive per energy output.

5. In all locations, the larger array is both more reliable (lower LOLP) and, in the long run, less expensive per energy output. Since the smaller trailer arrays appear inadequate to carry a significant load, the large array with moderate storage capacity appears to be the most cost effective solar energy system.

SECTION 6

TRANSPORTABLE PHOTOVOLTAIC SYSTEM CHARACTERISTICS

In this section, the results of the sizing analysis described in Section 5 are presented, as well as an understanding of how to interpret the performance charts for the separate locations and individual trailers.

As described in Section 4 the objective in presenting this information was to provide the basis for decisions concerning which system to use for a given location and load. For this reason charts have been presented at the end of this section which summarize performance characteristics (availability) as a function of load, duty cycle and trailer size for ten representative locations. Data in these charts is based on the assumption that the trailer is oriented to the equator and tilted to the appropriate latitude. Improvement may be realized by optimizing both tilt and orientation with respect to the daily and seasonal position of the sun.

6.1 Use of the Performance Charts

The charts at the end of this section present the loss-of-load-probability and availability for three trailer systems at ten locations under a variety of load conditions. The charts are presented in order of best performance first and worst last, by location. The ranking is the same as presented in Section 3.

These Section 6 charts present only data for applications where availability is greater than or equal to 80 percent. When availability drops below 80 percent a dashed line masks the data and when the system is simply too small to meet the load at all then "N/A" is inserted.

Four major columns represent the load in watts with four minor columns under each of these representing the percentage of 24 hours the load is supplied. The rows of the chart present the loss-of-load-probability and availability for each of the trailers. Two charts for each location present a total of five possible array, battery and trailer combinations. LOLP and availability are first given on an average annual basis but this alone is not enough to give a feeling for the application on a seasonal basis. For this reason minimum and maximum LOLP's are also provided in the last two rows of each trailer's data, minimum and maximum refer to the smallest and largest LOLP occurring during any month of the year.

In Honolulu, Hawaii, for example, the number one small trailer, when used with a 250 watt load supplied 25 percent of the time will be available 88.1 percent of the time (LOLP = 11.9 percent) on an annual basis. Referring to the min/max rows, however, one sees that the LOLP ranges from 0 to 100 percent. For more detailed information the user must refer to the Appendix of this report where the complete computer output is presented on a monthly basis and interpret the appropriate chart as it is explained there. Doing so for the given trailers and load in Honolulu reveals that December availability drops to 0% and January just exceeds 60 percent, but all other months exceed 95 percent availability.

If then the range of LOLP extremes on the condensed chart exceeds acceptable limits for the user, then the user must interpret the more detailed data to determine whether or not the time of year for intended use is prohibitive.

An example of a case not requiring use of the Appendix charts would be in the chart for Jerusalem, Israel, the best location presented. Looking at the large trailer for a 1,000 watt load used 50 percent of the time reveals that availability averages 99.4 percent year round. The range of LOLP is from 0 to 7.5 percent (availability = 92.5 to 100 percent). Providing that a 7.5 percent is not unacceptable, the large trailer could be selected for this application with no further examination.

Presented in this way the decision to deploy a photovoltaic power system trailer requires only four inputs:

- The location of interest
- The load size in watts
- The percentage duty for the load in 24 hours on an average
- The maximum acceptable LOLP

Beginning with the selection of location a chart is selected at or near the proposed site. More charts may be generated for any location for which meterological data is available, including more than 200 sites worldwide. On the appropriate chart from Section 6, the load size and the duty factor beneath it which most nearly corresponds to the percentage use are selected. Reading down this column the decision maker checks the overall availability of each trailer. For those which meet their acceptability criteria, they must check the min/max range of LOLP and see if it is also acceptable (referring to Appendix A if necessary). Of those trailers which meet the performance criteria, one may wish to select the smallest for ease of transportation or perhaps a larger trailer if multiple destinations are planned where other loads or conditions prevail. This decision is strictly a logistic one depending on other parameters as well as performance.

System economics may be a governing factor if a decision is being made between a photovoltaic system and a diesel generator set, for example. In this situation, reference to Sections 2 and 5 of this report will help to clarify this issue. In cases where the small trailer is feasible (for example with smaller loads) the busbar energy costs may be considerably lower than for an under-utilized large trailer.

On the other hand, perhaps the difference in availability may be between 90 and 95 percent for a small and a large trailer. A look at the energy costs for the two options will reveal the marginal costs for that extra five percent availability with the large trailer. That cost may frequently be found to be quite high.

For many applications, especially temporary ones, energy cost analysis will not be pertinent when taken as a busbar cost over a full years' operation. More important will be the capital cost of alternatives and the comparative reliability of alternate systems.

6.2 A General Overview of Systems and Applications

As was briefly mentioned in Section 3, it is noteworthy that a distinction forms between insolation in regions approaching the equator and regions approaching the poles. The regions about 40° latitude seem to degenerate uniformly in insolation levels with increasing latitude largely independent of site specific variations. Below 40° latitude performance seems more highly site specific. Local conditions such as smog, of course, alter this conclusion. It is important also to note that the higher latitudes experience wider discrepancies in performance than do the lower ones.

If these tendencies hold true over the sites of interest then the following two decision strategies are suggested. First, in higher latitudes, a trailer which will serve a load in one location will very likely serve the same load in another location at the same or proximate latitude because performance here is dependent heavily on latitude. Progressively larger photovoltaic systems are required as latitude increases.

Secondly, in regions below 40° and especially below 30°, although performance is considerably more dependent on sites than latitude, the performance between one site and another does not vary that dramatically because insolation is generally high. This suggests that a trailer deployed in an equatorial or sub-tropical region would also have a wide range of applications in other adjacent regions, not only going east and west as before, but also covering quite a range of latitudes north and south.

A look at worldwide insolation maps tends to bear these conclusions out in a general sense. The isolines of constant solar insolation tend to be fairly smooth east to west in latitudes above 40°. Below 30° however, they tend to form in more isolated circular patterns but the intensity remains very high throughout the gradient. See Figure 6-1.

Another more striking conclusion brought out by the results of the computer simulation is the surprisingly limited utility of a small trailer loaded with photovoltaic array and battery. Even in Jerusalem where conditions were the best, the smallest trailer (3.5 m^2 array and 6 kWh battery) served only the smallest load (125 W) and smallest duty cycle (25 percent) with better than an 80 percent availability. The next largest trailer with 5.0 meters of array improved performance by 43 percent but still only served 250 watts 25 percent of the time.

As previously stated, the sizing of array and battery was based on trailer capacity primarily. Even though these physical constraints exist, analysis was performed of a small trailer with 13 m^2 array and 5 kWh of battery storage. This resulted in a performance improvement of 172 percent over the 5 m^2 array and 290 percent over the 3.5 m^2 array, making it possible in Jerusalem, at least, to run loads of 500 W up to 25 percent of the time. Even in Munich, this configuration would

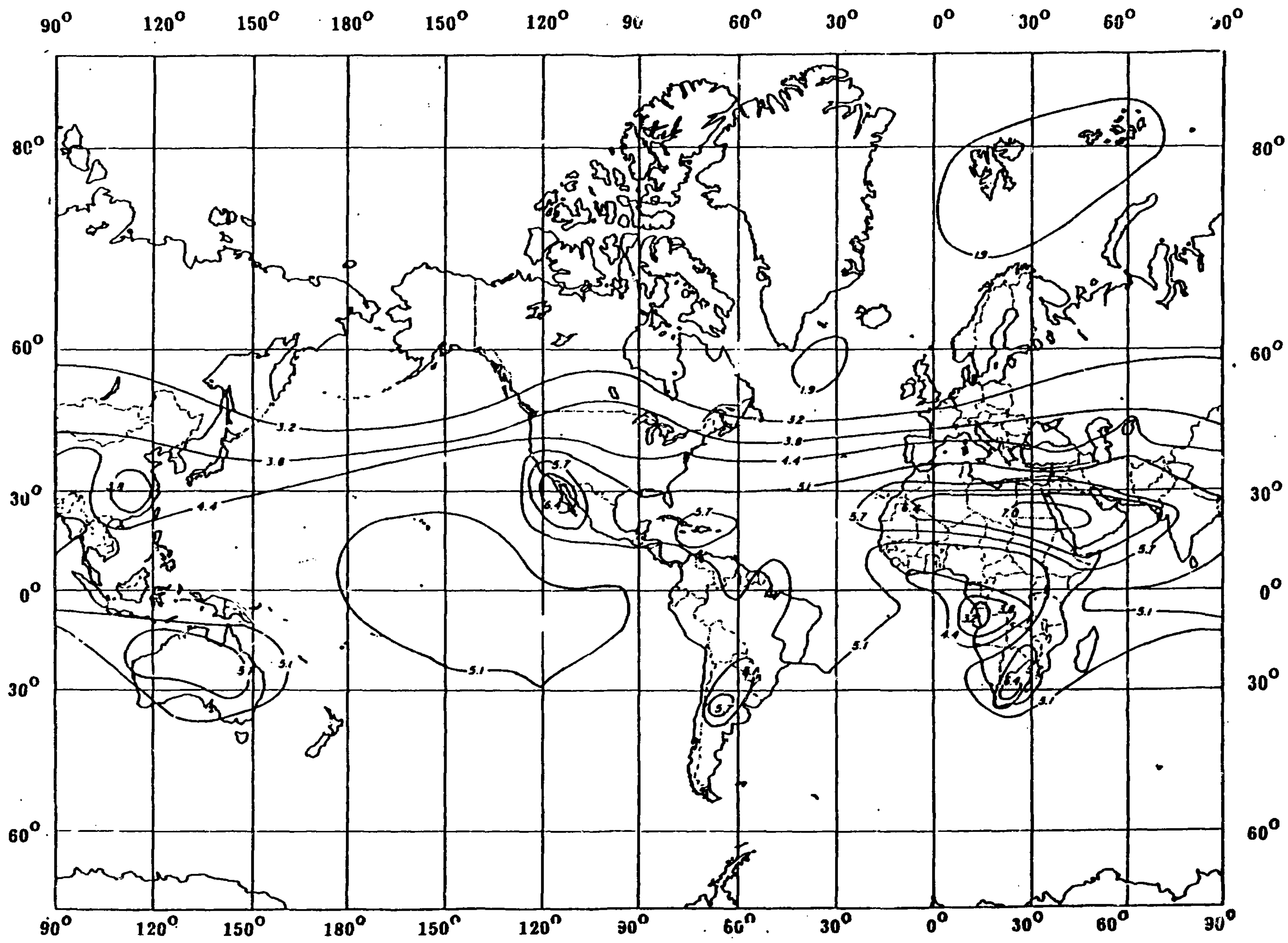


Figure 7-1

AVERAGE ANNUAL DISTRIBUTION OF SOLAR RADIATION (kWh/m^2 day)

manage 250 W at 25 percent duty cycle with 83 percent availability.

Because of the large array area of a 13 m^2 array on the small trailers extreme measures would have to be taken to eliminate the sail effect in strong winds if such a trailer were to be made. This could entail extra long outriggers, extensive guy wires and reinforced panel structure. Set up also would be more time consuming.

All of this effort would increase the size and weight of the smaller trailer and still only serve a load of a few hundred watts at most.

Certainly some electrical needs can be served at these levels, but the demand for those small loads must certainly be considered in deciding whether to produce such a small system in addition to the larger one.

Conclusion:

If sufficient demand exists for exclusively small loads or very small duty cycles, then a small trailer can certainly provide an economic option. If on the other hand demand is small or occasional for small loads, perhaps only the larger trailer will prove economic. Again, reference to the energy cost analysis of Section 5 will prove helpful in this case.

[illegible] JERUSALEM, ISRAEL   LATITUDE : 31.8

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LEG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6	---	---
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.4	100.0	99.4	---	---
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	7.5	---	---
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---
SM 1 TRAILER																
LOLP	0.0	0.4	---	---	0.4	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	99.6	---	---	99.6	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	4.6	---	---	4.6	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	---	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LEG TRAILER ARRAY (SQ. METERS) : 40.0   BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0   BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5   BATTERY SIZE (kWh) : 6.0

LOCATION : JERUSALEM, ISRAEL LATITUDE : 31.8

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	---	0.0	---	---	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	94.2	---	100.0	---	---	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	60.7	---	0.1	---	---	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	---	---	N/A
SM. TRAILER																
LOLP	0.0	0.0	---	---	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	100.0	---	---	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.3	---	---	0.3	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	---	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : HONOLULU, HAWAII   LATITUDE : 21.3

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.0	13.3	---	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.7	100.0	86.7	---	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	---	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	N/A
SM 1 TRAILER																
LOLP	0.0	11.9	---	N/A	11.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	88.1	---	N/A	88.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	100.0	---	N/A	100.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	N/A	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0 BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0 BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5 BATTERY SIZE (kWh) : 6.0

LOCATION : HONOLULU, HAWAII   LATITUDE : 21.3

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	---	---	0.1	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	100.0	99.9	---	---	99.9	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6	---	---	0.6	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	N/A	N/A
SM. TRAILER																
LOLP	0.0	0.4	---	N/A	0.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	99.6	---	N/A	99.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	2.3	---	N/A	2.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	N/A	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : ALBROOK A B, PAN LATITUDE : 8.6

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	---	0.0	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	---	100.0	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	---	0.0	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	---	N/A	N/A
SM 1 TRAILER																
LOLP	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0 BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0 BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5 BATTERY SIZE (kWh) : 6.0

LOCATION : ALBROOK A B, PAN   LATITUDE : 8.6

LG. TRAILER ARRAY (SQ. METERS) : 60.0   BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0   BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.1	0.0	1.1	---	---	1.1	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	99.9	98.9	100.0	98.9	---	---	98.9	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.1	0.0	0.1	0.7	6.8	0.1	6.8	---	---	6.8	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	N/A	N/A
SM. TRAILER																
LOLP	0.0	3.6	---	N/A	3.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	96.4	---	N/A	96.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.1	26.4	---	N/A	26.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	N/A	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : ALMERIA, SPAIN LATITUDE : 37.0

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	---	0.0	---	---	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.0	---	100.0	---	---	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	---	0.0	---	---	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	---	---	N/A
SM 1 TRAILER																
LOLP	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0 BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0 BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5 BATTERY SIZE (kWh) : 6.0

LOCATION : ALMERIA, SPAIN LATITUDE : 37.0

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4	0.0	1.4	---	---	1.4	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	99.9	98.6	100.0	98.6	---	---	98.6	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.7	12.6	0.0	12.6	---	---	12.6	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	N/A	N/A
SM. TRAILER																
LOLP	0.0	9.6	---	---	9.6	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	90.4	---	---	90.4	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	96.3	---	---	96.3	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	---	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : SAN ANTONIO, TEX   LATITUDE : 29.5

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	---	0.0	---	---	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	93.9	---	100.0	---	---	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	---	0.0	---	---	[illegible]
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	---	---	[illegible]
SM 1 TRAILER																
LOLP	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0 BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0 BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5 BATTERY SIZE (kWh) : 6.0

LOCATION : SAN ANTONIO, TEX   LATITUDE : 29.5

LG. TRAILER ARRAY (SQ. METERS) : 60.0   BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0   BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.9	0.0	1.9	---	---	1.9	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	99.9	98.1	100.0	98.1	---	---	98.1	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.7	11.1	0.0	11.1	---	---	11.1	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	N/A	N/A
SM. TRAILER																
LOLP	0.0	10.9	---	---	10.9	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	89.1	---	---	89.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.1	71.1	---	---	71.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.0	---	---	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : SEOUL, KOREA LATITUDE : 37.6

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	---	0.0	---	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	94.7	---	100.0	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.0	---	0.0	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	---	N/A	N/A
SM 1 TRAILER																
LOLP	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	0.1	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	99.9	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	1.2	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0 BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0 BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5 BATTERY SIZE (kWh) : 6.0

LOCATION : SEOUL, KOREA LATITUDE : 37.6

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.9	0.0	3.9	---	N/A	3.9	N/A	N/A	N/A
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	99.8	96.1	100.0	96.1	---	N/A	96.1	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.1	0.0	0.1	1.5	30.7	0.1	30.7	---	N/A	30.7	N/A	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	---	N/A	0.2	N/A	N/A	N/A
SM. TRAILER																
LOLP	0.0	14.5	---	N/A	14.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	100.0	85.5	---	N/A	85.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.1	100.0	---	N/A	100.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	0.2	---	N/A	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : WASHINGTON DC   LATITUDE : 39.0

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	[illegible]
LRG TRAILER																
LOLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	4.3	---	---	4.3	---	[illegible]	[illegible]
AVAIL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	[illegible].7	100.0	95.7	---	---	95.7	---	[illegible]	[illegible]
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.5	48.1	0.0	48.1	---	---	48.1	---	[illegible]	[illegible]
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	[illegible]	[illegible]
SM 1 TRAILER																
LOLP	3.2	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
AVAIL	96.8	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]	[illegible]	N/A	[illegible]
LOSS OF LOAD EXTREMES																
MAX	36.4	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]	[illegible]
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]	[illegible]	[illegible]
SM 2 TRAILER																
LOLP	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]	[illegible]
AVAIL	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]	[illegible]	[illegible]
LOSS OF LOAD EXTREMES																
MAX	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
MIN	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]

LRG TRAILER ARRAY (SQ. METERS) : 40.0   BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0   BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5   BATTERY SIZE (kWh) : 6.0

LOCATION : WASHINGTON DC LATITUDE : 39.0

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.0	0.1	0.5	0.0	0.5	11.6	---	0.5	---	---	---	---	---	N/A	N/A
AVAIL	100.0	100.0	99.9	99.5	100.0	99.5	88.4	---	99.5	---	---	---	---	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.1	0.8	4.1	0.1	4.1	100.0	---	4.1	---	---	---	---	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	---	---	---	---	---	N/A	N/A
SM. TRAILER																
LOLP	1.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	99.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	8.7	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : MUNICH,W GERMANY   LATITUDE : 48.1

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	0.0	1.8	0.0	1.8	16.7	16.8	1.8	16.8	---	---	16.8	---	N/A	N/A
AVAIL	100.0	100.0	100.0	98.2	100.0	98.2	83.3	83.2	98.2	83.2	---	---	83.2	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.0	0.4	21.0	0.0	21.0	100.0	100.0	21.0	100.0	---	---	100.0	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	N/A	N/A
SM 1 TRAILER																
LOLP	16.7	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	83.3	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	100.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0   BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0   BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5   BATTERY SIZE (kWh) : 6.0

LOCATION : MUNICH,W GERMANY LATITUDE : 48.1

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.0	0.4	8.9	14.1	0.4	14.1	18.7	---	14.1	---	---	N/A	---	N/A	N/A	N/A
AVAIL	100.0	99.6	91.1	85.9	99.6	85.9	81.3	---	85.9	---	---	N/A	---	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.2	4.3	00.0	100.0	4.3	100.0	100.0	---	100.0	---	---	N/A	---	N/A	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	---	0.0	---	---	N/A	---	N/A	N/A	N/A
SM. TRAILER																
LOLP	16.8	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	83.2	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	100.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	0.0	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : CAMBRIDGE, U.K.   LATITUDE : 52.2

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	0.0	1.0	9.4	0.0	9.4	---	---	9.4	---	---	---	---	---	N/A	N/A
AVAIL	100.0	100.0	99.0	90.6	100.0	90.6	---	---	90.6	---	---	---	---	---	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.0	0.1	11.0	100.0	0.1	100.0	---	---	100.0	---	---	---	---	---	N/A	N/A
MIN	0.0	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	---	---	---	---	N/A	N/A
SM 1 TRAILER																
LOLP	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SM 2 TRAILER																
LOLP	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LRG TRAILER ARRAY (SQ. METERS) : 40.0   BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0   BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5   BATTERY SIZE (kWh) : 6.0

LOCATION : CAMBRIDGE, U.K.   LATITUDE : 52.2

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	0.1	2.6	16.0	---	2.6	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
AVAIL	99.9	97.4	84.0	---	97.4	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	0.5	23.8	100.0	---	23.8	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
MIN	0.0	0.0	0.1	---	0.0	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
SM. TRAILER																
LOLP	---	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	---	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	---	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	---	---	---	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LOCATION : JUENEAU, ALASKA   LATITUDE : 58.4

LOAD (WATTS)	125				250				500				1000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LRG TRAILER																
LOLP	0.0	8.3	9.3	---	8.3	---	---	---	---	---	---	---	---	---	N/A	[illegible]
AVAIL	100.0	91.7	90.7	---	91.7	---	---	---	---	---	---	---	---	---	N/A	[illegible]
LOSS OF LOAD EXTREMES																
MAX	0.0	100.0	100.0	---	100.0	---	---	---	---	---	---	---	---	---	N/A	[illegible]
MIN	0.0	0.0	0.0	---	0.0	---	---	---	---	---	---	---	---	---	N/A	[illegible]
SM 1 TRAILER																
LOLP	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
AVAIL	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
LOSS OF LOAD EXTREMES																
MAX	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
MIN	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
SM 2 TRAILER																
LOLP	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
AVAIL	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
LOSS OF LOAD EXTREMES																
MAX	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
MIN	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]

LRG TRAILER ARRAY (SQ. METERS) : 40.0 BATTERY SIZE (kWh) : 35.0
SM 1 TRAILER ARRAY (SQ. METERS) : 5.0 BATTERY SIZE (kWh) : 5.0
SM 2 TRAILER ARRAY (SQ. METERS) : 3.5 BATTERY SIZE (kWh) : 6.0

LOCATION : JUENEAU, ALASKA LATITUDE : 58.4

LG. TRAILER ARRAY (SQ. METERS) : 60.0 BATTERY SIZE (kWh) : 20.0
SM. TRAILER ARRAY (SQ. METERS) : 13.0 BATTERY SIZE (kWh) : 5.0

LOAD (WATTS)	250				500				1000				2000			
% DUTY	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
LG. TRAILER																
LOLP	3.8	11.4	---	---	11.4	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
AVAIL	96.2	88.6	---	---	88.6	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	44.1	100.0	---	---	100.0	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
MIN	0.0	0.1	---	---	0.1	---	---	---	---	---	---	N/A	---	N/A	N/A	N/A
SM. TRAILER																
LOLP	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AVAIL	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LOSS OF LOAD EXTREMES																
MAX	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIN	---	---	N/A	N/A	---	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX A

COMPUTER RUNS

(SUPPLIED PREVIOUSLY)

APPENDIX A

This appendix contains the detailed output from the computer runs analysing the performance of five photovoltaic trailer array configurations. These were:

Trailer	Array (m^2)	Battery Storage (kWh)
Large	60	20
Large	40	35
Small	13	5
Small	5	5
Small	3.5	6

The output presented here is shown on a more detailed (monthly) basis than dealt with in the body of the report.

To read the charts note the fact that each one was generated for a single load, either 1000 or 2000 watts, and a range of duty factors. Smaller loads must be interpreted by the appropriate duty factor of the larger load. For example, using the chart for Jerusalem covering the 60 m^2 array and 20 kWh battery, find the availability for 1000W at 75% duty cycle in the month of December.

Step 1. $\frac{2000}{1000}$ = 50% (the column equivalent to 1000W at 100% duty factor)

Step 2. 50% x 75% = 37.5% (the column of interest, 1000W at 75% duty cycle)

Step 3. Read down the 37.5% column to find LOLP for December. It is .60740, therefore availability = 1 - .60740 = .3926 or 39%

Conclusion: If a 75% duty cycle for a 1000W load is required in Jerusalem in the month of December with an availability of 80% or better, this system will probably fail to meet the load with sufficient reliability. Note however, that performance in all the other months exceeds the requirements.

For convenience the charts are arranged as before in order of best performing locations first. For each location the system sizes are presented in order of decreasing array size.

CITY : JERUSALEM, ISRAEL
LATITUDE : 31.8
TILT ANGLE : 31.8
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.610	.00000	.0000*	.0000*	.0000*	.00001	.00013	.06856	9.99999	9.99999	9.99999
FEB	KH=.614	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00714	1.00000	9.99999	9.99999
MAR	KH=.622	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00055	.42620	9.99999	9.99999
APR	KH=.680	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00006	9.99999	9.99999
MAY	KH=.712	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.32485	9.99999
JUN	KH=.752	0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00003	9.99999
JUL	KH=.750	0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00012	9.99999
AUG	KH=.749	0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.01024	9.99999
SEP	KH=.732	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	9.99999	9.99999
OCT	KH=.698	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00094	9.99999	9.99999
NOV	KH=.620	.00000	.0000*	.0000*	.0000*	.00000	.00003	.01535	9.99999	9.99999	9.99999
DEC	KH=.588	.00000	.0000*	.0000*	.00000	.00005	.00089	.60740	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.0000*	.0000*	.00000	.00009	.05825	.36893	.69460	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	1.00000	1.00000	.99991	.94175	.63107	.30540	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.0000*	.0000*	.00000	.00005	.00089	.60740	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00003	9.99999

CITY : JERUSALEM, ISRAEL
LATITUDE : 31.8
TILT ANGLE : 31.8
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.610	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00163	9.99999	9.99999
FEB	KH=.614	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00063	9.99999	9.99999
MAR	KH=.622	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	9.99999	9.99999
APR	KH=.680	0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	[illegible]
MAY	KH=.712	0.00000	0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.01800
JUN	KH=.752	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.00000	.0000*	[illegible]
JUL	KH=.750	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.00000	.0000*	[illegible]
AUG	KH=.749	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.00000	.0000*	.00002
SEP	KH=.732	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.00000	.0000*	.0000*	[illegible]
OCT	KH=.698	0.00000	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00662	[illegible]
NOV	KH=.620	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00011	9.99999	9.99999
DEC	KH=.588	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.07543	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00643	.41722	.66818
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	.99357	.58278	.33182
ANNUAL LOLP MAXIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.07543	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.00000	.0000*	.0000*

CITY : JERUSALEM, ISRAEL
LATITUDE : 31.8
TILT ANGLE : 31.8
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1% 1.5	6.3% 3.0	9.4% 4.5	12.5% 6.0	18.8% 9.0	25.0% 12.0	37.5% 18.0	50.0% 24.0	75.0% 36.0	100.0% 46.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.610	.00000	.00038	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.614	.00000	.00005	.10770	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.622	.00000	.00000	.00579	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.680	.00000	.0000*	.0000*	.00223	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.712	.00000	.0000*	.0000*	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.752	.00000	.0000*	.0000*	.0000*	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.750	.00000	.0000*	.0000*	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.749	.00000	.0000*	.0000*	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.732	.00000	.0000*	.0000*	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.698	.00000	.0000*	.00000	.71406	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.620	.00000	.00008	.35417	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.588	.00000	.00321	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00031	.20564	.47636	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.99969	.79436	.52364	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.00321	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : [illegible], ISRAEL
LATITUDE : [illegible]
TILT ANGLE : 31.8
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.610	.0000	.00070	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.614	.00000	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.622	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.680	.00000	.0000*	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.712	.00000	.0000*	.0000*	.00930	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.752	0.00000	0.00000	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.750	0.00000	0.00000	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.739	0.00000	0.00000	.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.732	0.00000	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.698	.00000	.0000*	.00305	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.620	.00000	.00004	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.599	.00000	.04578	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00388	.41692	.66744	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.99612	.58308	.33256	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.04578	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		0.00000	0.00000	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : JERUSALEM,ISRAEL
LATITUDE : 31.8
TILT ANGLE : 31.8
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day									
	3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
	.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS	8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN KH=.610	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB KH=.614	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR KH=.622	.00000	.71254	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR KH=.680	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY KH=.712	0.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN KH=.752	0.00000	0.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL KH=.750	0.00000	0.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG KH=.749	0.00000	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP KH=.732	0.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT KH=.698	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV KH=.620	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC KH=.586	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0	.00000	.39271	.83333	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0	1.00000	.60729	.16667	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0	0.00000	0.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : HONOLULU, HAWAII
LATITUDE : 21.3
TILT ANGLE : 21.3
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.517	.00000	.00000	.00001	.00003	.00038	.00493	1.00000	9.99999	9.99999	9.99999
FEB	KH=.533	.00000	.0000*	.00000	.00001	.00008	.00097	.15979	9.99999	9.99999	9.99999
MAR	KH=.539	.00000	.0000*	.0000*	.00000	.00002	.00027	.03517	9.99999	9.99999	9.99999
APR	KH=.544	.00000	.0000*	.0000*	.00000	.00001	.00014	.01027	1.00000	9.99999	9.99999
MAY	KH=.566	.00000	.0000*	.0000*	.0000*	.00000	.00003	.00709	.24523	9.99999	9.99999
JUN	KH=.576	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00109	.12166	9.99999	9.99999
JUL	KH=.580	.00000	.0000*	.0000*	.0000*	.00000	.00001	.00089	.10730	9.99999	9.99999
AUG	KH=.586	.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00073	.12224	9.99999	9.99999
SEP	KH=.578	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00260	1.00000	9.99999	9.99999
OCT	KH=.554	.00000	.0000*	.0000*	.00000	.00002	.00020	.03296	9.99999	9.99999	9.99999
NOV	KH=.526	.00000	.00000	.00000	.00001	.00018	.00231	.59649	9.99999	9.99999	9.99999
DEC	KH=.518	.00000	.00000	.00001	.00003	.00343	.00631	1.00000	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.00000	.00001	.00010	.00127	.23684	.71637	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	.99999	.99990	.99873	.76316	.28363	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.00000	.00001	.00003	.00043	.00631	1.00000	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00073	.10730	9.99999	9.99999

CITY : HONOLULU, HAWAII
LATITUDE : 21.3
TILT ANGLE : [illegible] .3
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1% .7	6.3% 1.5	9.4% 2.2	12.5% 3.0	18.8% 4.5	25.0% 6.0	37.5% 9.0	50.0% 12.0	75.0% 18.0	100.0% 24.0
										1.9	1.5
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9		
JAN	KH=.517	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00020	.49934	9.99999	9.99999
FEB	KH=.533	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.00933	9.99999	9.99999
MAR	KH=.539	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.00068	9.99999	9.99999
APR	KH=.544	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00008	9.99999	9.99999
MAY	KH=.566	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	1.00000	9.99999
JUN	KH=.576	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.84647	9.99999
JUL	KH=.580	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.71628	9.99999
AUG	KH=.586	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	1.00000	9.99999
SEP	KH=.578	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	9.99999	9.99999
OCT	KH=.554	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00056	9.99999	9.99999
NOV	KH=.526	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00005	.08350	9.99999	9.99999
DEC	KH=.518	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00032	1.00000	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00005	.13279	.96355	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	.99995	.86721	.03644	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00032	1.00000	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.71628	9.99999

CITY : HONOLULU, HAWAII
LATITUDE : 21.3
TILT ANGLE : 21.3
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.517	.00003	.01663	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.533	.00001	.00246	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.539	.00000	.00060	.40960	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.544	.00000	.00024	.06764	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.566	.00000	.00005	.01105	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.576	.00000	.00002	.00537	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.580	.00000	.00002	.00451	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.586	.00000	.00001	.00424	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.578	.00000	.00003	.02250	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.554	.00000	.00046	.43879	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.526	.00001	.00688	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.518	.00003	.02296	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00001	.00420	.41364	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99999	.99580	.58636	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00003	.02296	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00001	.00424	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : HONOLULU, HAWAII
LATITUDE : 21.3
TILT ANGLE : 21.3
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.517	.00000	.37528	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.533	.00000	.00486	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.539	.00000	.00029	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.544	.00000	.00003	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.566	.00000	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.576	.00000	.0000*	.65147	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.580	.00000	.0000*	.54872	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.586	.00000	.0000*	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.578	.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.554	.00000	.00023	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.526	.00000	.05227	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.518	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.11942	.93335	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.88058	.06665	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.54872	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : HONOLULU, HAWAII
LATITUDE : 21.3
TILT ANGLE : 21.3
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY / # OF DAYS		DUTY FACTORS & kWh/day 3.1% .7 8.0	6.3% 1.5 4.0	9.4% 2.2 2.7	12.5% 3.0 2.0	18.8% 4.5 1.3	25.0% 6.0 1.0	37.5% 9.0 .7	50.0% 12.0 .5	75.0% 18.0 .3	100.0% 24.0 .3
JAN	KH=.517	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.533	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.539	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.544	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.566	.00000	.03420	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.576	.00000	.00475	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.580	.00000	.00346	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.586	.00000	.00583	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.578	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.554	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.526	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.518	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.67069	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.32931	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00346	0.00000	0.00000	0.00000	0.00000	9.99999	9.99999	9.99999	9.99999

CITY : ALBROOK A B, PAN
LATITUDE : 8.6
TILT ANGLE : 8.6
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
% OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.505	.00000	.00000	.00000	.00001	.00013	.00161	.33966	9.99999	9.99999	9.99999
FEB	KH=.572	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00405	1.00000	9.99999	9.99999
MAR	KH=.596	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00040	.19186	9.99999	9.99999
APR	KH=.554	.00000	.0000*	.0000*	.0000*	.00000	.00004	.00535	1.00000	9.99999	9.99999
MAY	KH=.459	.00000	.00001	.00002	.00005	.00054	.00527	.67018	9.99999	9.99999	9.99999
JUN	KH=.390	.00001	.00006	.00018	.00061	.00676	.06758	9.99999	9.99999	9.99999	9.99999
JUL	KH=.428	.00000	.00002	.00006	.00018	.00188	.01850	1.00000	9.99999	9.99999	9.99999
AUG	KH=.422	.00000	.00002	.00007	.00022	.00218	.02020	1.00000	9.99999	9.99999	9.99999
SEP	KH=.508	.00000	.0000*	.00000	.00000	.00005	.00056	.06669	9.99999	9.99999	9.99999
OCT	KH=.457	.00000	.00001	.00002	.00008	.00074	.00745	1.00000	9.99999	9.99999	9.99999
NOV	KH=.478	.00000	.00000	.00001	.00004	.00042	.00480	.98222	9.99999	9.99999	9.99999
DEC	KH=.554	.00000	.0000*	.0000*	.0000*	.00001	.00014	.03692	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00001	.00003	.00010	.00106	.01051	.50879	.93266	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.99999	.99997	.99990	.99894	.98949	.49121	.06734	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00001	.00006	.00018	.00061	.00676	.06758	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00040	.19186	9.99999	9.99999

CITY : ALBROOK A B, PAN
LATITUDE : 8.6
TILT ANGLE : 8.6
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.505	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00003	.03312	0.00000	0.00000
FEB	KH=.577	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	0.00000	0.00000
MAR	KH=.596	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	1.00000	0.00000
APR	KH=.554	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	0.00000	0.00000
MAY	KH=.459	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00018	.11803	0.00000	0.00000
JUN	KH=.390	.00000	.0000*	.0000*	.0000*	.00000	.00005	.07340	0.99900	0.00000	0.00000
JUL	KH=.428	.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00195	1.00000	0.00000	0.00000
AUG	KH=.422	.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00226	1.00000	0.00000	0.00000
SEP	KH=.508	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00009	.00218	9.99999	0.00000
OCT	KH=.457	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00036	.25507	9.99999	0.00000
NOV	KH=.478	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00017	.18208	0.00000	0.00000
DEC	KH=.554	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00161	0.99990	0.00000
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00236	.30018	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	1.00000	1.00000	.99999	.99764	.69982	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.00000	.00005	.02340	0.00000	0.00000	0.00000
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	1.00000	0.00000

CITY : ALBROOK A B, PAN
LATITUDE : 8.6
TILT ANGLE : 8.6
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day										
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.505	.00001	.00450	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.572	.00000	.00004	.04109	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.596	.00000	.00000	.00344	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.554	.00000	.00008	.04499	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.459	.00005	.01384	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.390	.00071	.26367	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.428	.00018	.05538	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.422	.00023	.05935	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.508	.00000	.00126	.07521	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.457	.00007	.02043	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.478	.00003	.01396	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.554	.00000	.00035	.70169	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00011	.03607	.72228	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99989	.96393	.27780	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00071	.26367	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00000	.00344	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

LATITUDE : 8.6
TILT ANGLE : 8.6
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.?	.2
JAN	KH=.505	.00000	.01925	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.572	.00000	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.596	.00000	.0000*	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.554	.00000	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.459	.00000	.07740	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.390	.00002	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.428	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.422	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.508	.00000	.00100	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.457	.00000	.18579	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.478	.00000	.13555	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.554	.00000	.00024	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.28502	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.71498	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00002	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : ALBROOK A B, PAN
LATITUDE : 8.6
TILT ANGLE : 8.6
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN	KH=.505	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.572	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.596	.00000	.04312	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.554	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.459	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.390	.00016	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.428	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.422	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.508	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.457	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.478	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.9999	9.99999	9.99999	9.99999
DEC	KH=.554	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00001	.92026	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99999	.07974	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00016	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.04312	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : ALMERIA, SPAIN
LATITUDE : 37.0
TILT ANGLE : 37.0
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY / # OF DAYS		DUTY FACTORS & kWh/day 3.1% 1.5 13.3	6.3% 3.0 6.7	9.4% 4.5 4.4	12.5% 6.0 3.3	18.8% 9.0 2.2	25.0% 12.0 1.7	37.5% 18.0 1.1	50.0% 24.0 .8	75.0% 36.0 .6	100.0% 48.0 .4
JAN	KH=.537	.00000	.00001	.00003	.00011	.00178	.02787	9.99999	9.99999	9.99999	9.99999
FEB	KH=.568	.00000	.0000*	.00000	.00001	.00011	.00147	.35608	9.99999	9.99999	9.99999
MAR	KH=.590	.00000	.0000*	.0000*	.0000*	.00001	.00007	.01340	1.00000	9.99999	9.99999
APR	KH=.602	.00000	.0000*	.0000*	.0000*	.00000	.00001	.00081	.08062	9.99999	9.99999
MAY	KH=.586	.00000	.0000*	.0000*	.0000*	.00001	.00004	.00103	.03954	9.99999	9.99999
JUN	KH=.595	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00047	.01565	9.99999	9.99999
JUL	KH=.614	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00014	.00616	9.99999	9.99999
AUG	KH=.611	.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00028	.01969	9.99999	9.99999
SEP	KH=.589	.00000	.0000*	.0000*	.0000*	.00000	.00005	.00533	1.00000	9.99999	9.99999
OCT	KH=.570	.00000	.0000*	.00000	.00000	.00005	.00065	.12955	9.99999	9.99999	9.99999
NOV	KH=.539	.00000	.00001	.00002	.00007	.00101	.01452	1.00000	9.99999	9.99999	9.99999
DEC	KH=.514	.00000	.00002	.00008	.00037	.00681	.12612	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00000	.00001	.00095	.00082	.01423	.29226	.59681	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	.99999	.99995	.99918	.98577	.70774	.40319	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.00002	.00008	.00037	.00681	.12612	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00014	.00616	9.99999	9.99999

CITY : AIJERIA, SPAIN
LATITUDE : 37.0
TILT ANGLE : 37.0
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.537	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00543	9.99999	9.99999	9.99999
FEB	KH=.568	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	.03532	9.99999	9.99996
MAR	KH=.590	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00011	9.99999	9.99999
APR	KH=.602	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.32923	9.99999
MAY	KH=.586	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.03642	9.99999
JUN	KH=.595	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.06564	9.99999
JUL	KH=.614	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.02122	9.99999
AUG	KH=.611	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.01616	9.99999
SEP	KH=.589	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	9.99999	9.99999
OCT	KH=.570	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.00623	9.99999	9.99999
NOV	KH=.539	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00147	1.00000	9.99999	9.99999
DEC	KH=.514	.00000	.0000*	.0000*	.0000*	.0000*	.00004	.11521	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00000	.01018	.25347	.61564	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	.98982	.74653	.39436	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00004	.11521	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS						[illegible]	[illegible]	.0000*	.0000*	.00122	9.99999

CITY : ALMERIA, SPAIN
LATITUDE : 37.0
TILT ANGLE : 37.0
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.537	.00012	.12910	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.568	.00001	.00416	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.590	.00000	.00016	.15789	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.602	.00000	.00002	.00379	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.586	.00000	.00005	.00318	.44115	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.595	.00000	.00007	.00130	.12301	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.614	.00000	.00000	.00040	.05055	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.611	.00000	.00001	.00105	.31122	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.589	.00000	.00008	.04373	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.570	.00000	.00168	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.539	.00007	.05640	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.514	.00048	.96257	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00006	.09619	.43428	.74383	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99994	.90381	.56572	.25617	0.00000	0.00000	0.00000	0.00000	1.00000	1.00000
ANNUAL LOLP MAXIMUMS 0.0		.00048	.96257	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00000	.00040	.05055	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : ALMERIA, SPAIN
LATITUDE : 37.0
TILT ANGLE : 37.0
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.537	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.568	.00000	.02055	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.590	.00000	.00004	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.602	.00000	.0000*	.23933	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.586	.00000	.0000*	.02200	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.595	.00000	.0000*	.00295	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.614	.00000	.0000*	.00055	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.611	.00000	.0000*	.00897	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.589	.00000	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.570	.00000	.00311	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.539	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.514	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.25198	.60615	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.74802	.39385	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.00055	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : ALMERIA, SPAIN
LATITUDE : 37.0
TILT ANGLE : 37.0
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN	KH=.537	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.568	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.590	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.602	.00000	.00136	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.586	.00000	.00013	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.595	.00000	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.614	.00000	.0000*	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.611	.00000	.00002	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.589	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.570	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.539	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.514	.00088	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00007	.58346	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99993	.41654	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00088	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CITY : SAN ANTONIO, TEX
LATITUDE : 29.5
TILT ANGLE : 29.5
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.478	.00001	.00003	.00010	.00041	.00602	.08551	9.99999	9.99999	9.99999	9.99999
FEB	KH=.508	.00000	.00001	.00002	.00005	.00068	.00814	1.00000	9.99999	9.99999	9.99999
MAR	KH=.522	.00000	.00000	.00000	.00001	.00012	.00130	.17927	9.99999	9.99999	9.99999
APR	KH=.502	.00000	.00000	.00001	.00003	.00019	.00158	.08443	9.99999	9.99999	9.99999
MAY	KH=.543	.00000	.0000*	.00000	.00000	.00003	.00020	.00727	.45250	9.99999	9.99999
JUN	KH=.576	.00000	.0000*	.0000*	.0000*	.00000	.00003	.00106	.05774	9.99999	9.99999
JUL	KH=.599	.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00027	.01853	9.99999	9.99999
AUG	KH=.583	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00114	.10563	9.99999	9.99999
SEP	KH=.551	.00000	.0000*	.0000*	.00000	.00002	.00020	.02133	1.00000	9.99999	9.99999
OCT	KH=.543	.00000	.0000*	.00000	.00001	.00007	.00093	.16107	9.99999	9.99999	9.99999
NOV	KH=.498	.00000	.00001	.00003	.00013	.00180	.02439	9.99999	9.99999	9.99999	9.99999
DEC	KH=.481	.00001	.00003	.00010	.00044	.00711	.11113	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00001	.00002	.00009	.00134	.01945	.37132	.71953	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.99999	.99998	.99991	.99866	.98055	.62868	.28047	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00001	.00003	.00010	.00044	.00711	.11113	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00001	.00027	.01853	9.99999	9.99999

CITY : SAN ANTONIO, TEX
LATITUDE : 29.5
TILT ANGLE : 29.5
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.478	.00000	.0000*	.0000*	.0000*	.00000	.00003	.04387	9.99999	9.99999	9.99999
FEB	KH=.508	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00046	.78783	9.99999	9.99999
MAR	KH=.522	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	.01202	9.99999	9.99999
APR	KH=.502	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	.00410	9.99999	9.99999
MAY	KH=.543	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00006	1.00000	9.99999
JUN	KH=.576	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.10217	9.99999
JUL	KH=.599	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.01457	9.99999
AUG	KH=.583	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00000	.52373	9.99999
SEP	KH=.551	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.00029	9.99999	9.99999
OCT	KH=.543	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.00943	9.99999	9.99999
NOV	KH=.498	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00380	9.99999	9.99999	9.99999
DEC	KH=.481	.00000	.0000*	.0000*	.0000*	.00000	.00004	.07960	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.00001	.01065	.31781	.80337	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	1.00000	1.00000	.99999	.98935	.68219	.19663	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.00000	.00004	.07960	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.0000*	.01457	9.99999

CITY : SAN ANTONIO, TEX
LATITUDE : 29.5
TILT ANGLE : 29.5
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.478	.00049	.46227	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.508	.00006	.02580	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.522	.00001	.00322	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.502	.00002	.00310	.69290	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.543	.00000	.00023	.03029	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.576	.00000	.00004	.00390	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.599	.00000	.00001	.00096	.29140	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.583	.00000	.00003	.00526	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.551	.00000	.00040	.19852	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.543	.00001	.00239	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.498	.00015	.09732	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.481	.00055	.71131	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00011	.10885	.57765	.94095	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99989	.89115	.42235	.05905	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00055	.71131	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00001	.00096	.29140	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : SAN ANTONIO, TEX
LATITUDE : 29.5
TILT ANGLE : 29.5
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.478	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.508	.00000	.60591	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.522	.00000	.00644	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.502	.00000	.00205	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.543	.00000	.00002	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.576	.00000	.0000*	.06654	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.599	.00000	.0000*	.00800	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.583	.00000	.0000*	.39434	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.551	.00000	.00011	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.543	.00000	.00492	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.498	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.481	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.30162	.78907	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.69838	.21093	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.00800	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : SAN ANTONIO, TEX
LATITUDE : 29.5
TILT ANGLE : 29.5
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN	KH=.478	.00028	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.508	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.522	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.502	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.543	.00000	.12735	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.576	.00000	.00042	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.599	.00000	.00002	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.583	.00000	.00287	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.551	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.543	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.498	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.481	.00060	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00007	.67755	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99993	.32245	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00060	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00002	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : SEOUL, KOREA
LATITUDE : 37.6
TILT ANGLE : 37.6
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.535	.00000	.00001	.00003	.00013	.00214	.03364	9.99999	9.99999	9.99999	9.99999
FEB	KH=.526	.00000	.00001	.00002	.00008	.00105	.01263	1.00000	9.99999	9.99999	9.99999
MAR	KH=.517	.00000	.00000	.00001	.00004	.00041	.00434	.76222	9.99999	9.99999	9.99999
APR	KH=.505	.00000	.00001	.00002	.00005	.00037	.00269	.11118	9.99999	9.99999	9.99999
MAY	KH=.510	.00000	.00001	.00002	.00005	.00026	.00157	.03396	1.00000	9.99999	9.99999
JUN	KH=.506	.00000	.00001	.00003	.00006	.00030	.00166	.02971	1.00000	9.99999	9.99999
JUL	KH=.465	.00001	.00005	.00010	.00026	.00137	.00707	.14441	1.00000	9.99999	9.99999
AUG	KH=.475	.00000	.00003	.00008	.00018	.00113	.00682	.20645	9.99999	9.99999	9.99999
SEP	KH=.509	.00000	.00000	.00001	.00004	.00039	.00354	.35034	9.99999	9.99999	9.99999
OCT	KH=.531	.00000	.00000	.00001	.00004	.00046	.00517	1.00000	9.99999	9.99999	9.99999
NOV	KH=.501	.00001	.00003	.00009	.00037	.00566	.08283	9.99999	9.99999	9.99999	9.99999
DEC	KH=.498	.00001	.00004	.00016	.00078	.01468	.30713	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00002	.00005	.00017	.00235	.03909	.55321	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.99998	.99995	.99983	.99765	.96091	.44679	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00001	.00005	.00016	.[illegible]078	.01468	.30713	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00000	.00001	.00004	.00026	.00157	.02971	1.00000	9.99999	9.99999

CITY : SEOUL, KOREA
LATITUDE : 37.6
TILT ANGLE : 37.6
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day									
	3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
	.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS	46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN KH=.535	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00807	9.99999	9.99999	9.99999
FEB KH=.526	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00105	1.00000	9.99999	9.99999
MAR KH=.517	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00014	.13624	9.99999	9.99999
APR KH=.505	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00005	.00726	9.99999	9.99999
MAY KH=.510	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	.00118	9.99999	9.99999
JUN KH=.506	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00003	.00102	1.00000	9.99999
JUL KH=.465	.00000	.0000*	.0000*	.0000*	.00000	.00001	.00032	.01463	9.99999	9.99999
AUG KH=.475	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00028	.02303	9.99999	9.99999
SEP KH=.509	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00009	.04155	9.99999	9.99999
OCT KH=.531	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00021	.29411	9.99999	9.99999
NOV KH=.501	.00000	.0000*	.0000*	.0000*	.00000	.00003	.04346	9.99999	9.99999	9.99999
DEC KH=.498	.00000	.0000*	.0000*	.0000*	.00000	.00014	.63989	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0	.00000	.0000*	.0000*	.0000*	.0000*	.00002	.05780	.37658	1.00000	1.00000
ANNUAL AVAILABILITY 0.0	1.00000	1.00000	1.00000	1.00000	1.00000	.99998	.94220	.62342	0.00003	0.00000
ANNUAL LOLP MAXIMUMS 0.0	.00000	.0000*	.0000*	.0000*	.00000	.00014	.63989	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00002	.00102	1.00000	9.99999

CITY : SEOUL, KOREA
LATITUDE : 37.6
TILT ANGLE : 37.6
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day									
	3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
	1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS	3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN KH=.535	.00015	.16399	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB KH=.526	.00008	.04296	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR KH=.517	.00003	.01216	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR KH=.505	.00005	.00513	.83199	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY KH=.510	.00004	.00246	.13272	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN KH=.506	.00005	.00253	.10338	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL KH=.465	.00024	.01233	.69084	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG KH=.475	.00016	.01250	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP KH=.509	.00004	.00855	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT KH=.531	.00004	.01589	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV KH=.501	.00044	.46125	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC KH=.498	.00104	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0	.00020	.14498	.81325	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0	.99980	.85502	.18675	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0	.00104	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0	.00003	.00246	.10338	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : SEOUL, KOREA
LATITUDE : 37.6
TILT ANGLE : 37.6
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.535	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.526	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.517	.00000	.09045	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.505	.00000	.00385	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.510	.00000	.00054	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.506	.00000	.00047	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.465	.00000	.00853	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.475	.00000	.01376	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.509	.00000	.02506	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.531	.00000	.21516	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.501	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.498	.00005	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00001	.36315	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99999	.63685	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00005	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00047	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : SEOUL, KOREA
LATITUDE : 37.6
TILT ANGLE : 37.6
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN	KH=.535	.00002	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.526	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.517	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.505	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.510	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.506	.00000	.65919	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.465	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.475	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.509	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.531	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.501	.00026	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.498	.01191	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00102	.97160	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99898	.02840	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.01191	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.65919	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : WASHINGTON DC
LATITUDE : 39.0
TILT ANGLE : 39.0
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 70.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.417	.00009	.00051	.00256	.01213	.23369	1.00000	9.99999	9.99999	9.99999	9.99999
FEB	KH=.447	.00003	.00013	.00050	.00198	.02496	.34862	9.99999	9.99999	9.99999	9.99999
MAR	KH=.460	.00001	.00004	.00012	.00043	.00472	.04735	9.99999	9.99999	9.99999	9.99999
APR	KH=.480	.00000	.00003	.00006	.00016	.00113	.00763	.32976	9.99999	9.99999	9.99999
MAY	KH=.496	.00000	.00002	.00004	.00010	.00052	.00290	.05842	1.00000	9.99999	9.99999
JUN	KH=.520	.00000	.00001	.00002	.00004	.00020	.00111	.01826	.49062	9.99999	9.99999
JUL	KH=.509	.00000	.00001	.00003	.00006	.00031	.00170	.03063	1.00000	9.99999	9.99999
AUG	KH=.499	.00000	.00001	.00003	.00008	.00048	.00306	.08542	1.00000	9.99999	9.99999
SEP	KH=.494	.00000	.00001	.00003	.00009	.00082	.00734	.84055	9.99999	9.99999	9.99999
OCT	KH=.479	.00001	.00003	.00011	.00038	.00477	.05250	9.99999	9.99999	9.99999	9.99999
NOV	KH=.420	.00008	.00037	.00169	.00762	.12057	1.00000	9.99999	9.99999	9.99999	9.99999
DEC	KH=.383	.00019	.00131	.00805	.04089	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00004	.00021	.00110	.00533	.11601	.28935	.61359	.95755	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99996	.99979	.99890	.99467	.88399	.71065	.38641	.04245	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00019	.00131	.00805	.04089	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00001	.00002	.00004	.00020	.00111	.01826	.49062	9.99999	9.99999

CITY : WASHINGTON DC
LATITUDE : 39.0
TILT ANGLE : 39.0
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.417	.00000	.0000*	.00000	.00001	.00047	.02217	9.99999	9.99999	9.99999	9.99999
FEB	KH=.447	.00000	.0000*	.0000*	.00000	.00002	.00048	.54182	9.99999	9.99999	9.99999
MAR	KH=.460	.00000	.0000*	.0000*	.0000*	.00000	.00003	.01171	9.99999	9.99999	9.99999
APR	KH=.480	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00034	.04576	9.99999	9.99999
MAY	KH=.496	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00006	.00305	9.99999	9.99999
JUN	KH=.520	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.00045	1.00000	9.99999
JUL	KH=.509	.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00003	.00105	1.00000	9.99999
AUG	KH=.499	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00007	.00523	9.99999	9.99999
SEP	KH=.494	.00000	.0000*	.0000*	.0000*	.0000*	.00000	.00035	.16712	9.99999	9.99999
OCT	KH=.479	.00000	.0000*	.0000*	.0000*	.00000	.00003	.01517	9.99999	9.99999	9.99999
NOV	KH=.420	.00000	.0000*	.00000	.00001	.00021	.00742	9.99999	9.99999	9.99999	9.99999
DEC	KH=.383	.00000	.00000	.00001	.00007	.00482	.48096	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.0000*	.00000	.00001	.00046	.04259	.29746	.51856	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	1.00000	1.00000	.99999	.99954	.95741	.70254	.48144	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00000	.00000	.00001	.00007	.00482	.48096	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.0000*	.0000*	.0000*	.0000*	.00001	.00045	1.00000	9.99999

CITY : WASHINGTON DC
LATITUDE : 39.0
TILT ANGLE : 39.0
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY / DUTY FACTORS & kWh/day / # OF DAYS		3.1% 1.5 3.3	6.3% 3.0 1.7	9.4% 4.5 1.1	12.5% 6.0 .8	18.8% 9.0 .6	25.0% 12.0 .4	37.5% 18.0 .3	50.0% 24.0 .2	75.0% 36.0 .1	100.0% 48.0 .1
JAN	KH=.417	.02066	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.447	.00264	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.460	.00047	.17027	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.480	.00015	.01545	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.496	.00008	.00472	.24097	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.520	.00003	.00157	.05669	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.509	.00005	.00260	.10753	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.499	.00007	.00535	.46304	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.494	.00008	.01896	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.479	.00044	.21096	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.420	.01211	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.383	.08685	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.01030	.36916	.73902	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.98970	.63084	.26098	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.08685	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00003	.00157	.05669	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : WASHINGTON DC
LATITUDE : 39.0
TILT ANGLE : 39.0
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.417	.01276	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.447	.00020	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.460	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.480	.00000	.02850	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.496	.00000	.00155	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.520	.00000	.00019	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.509	.00000	.00050	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.499	.00000	.00274	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.494	.00000	.11844	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.479	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.420	.00390	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.383	.36385	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.03173	.51266	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.96827	.48734	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.36385	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00019	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : WASHINGTON DC
LATITUDE 39.0
TILT ANG : 39.0
LOAD (WI S) : 1000.
ARRAY ARE SQ. METERS) : 3.5
ARRAY EFF ENCY (%) : 10.0
BATTERY E. CIENCY (%) : 75.0 BATTER. .APACITY (kWh) : 6.0

BATTERY CAPA TY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN	K .417	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.447	.01579	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.460	.00005	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.480	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.496	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.520	.00000	.10169	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.509	.00000	.75458	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.499	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.494	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.479	.00007	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.420	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.383	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.25133	.90469	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.74867	.09531	0.00000	0.0[illegible]	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.10169	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : MUNICH,W GERMANY
LATITUDE : 48.1
TILT ANGLE : 48.1
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.474	.00005	.00027	.00146	.00769	.18101	1.00000	9.99999	9.99999	9.99999	9.99999
FEB	KH=.491	.00002	.00008	.00032	.00133	.01887	.29072	9.99999	9.99999	9.99999	9.99999
MAR	KH=.488	.00001	.00003	.00011	.00038	.00458	.04873	9.99999	9.99999	9.99999	9.99999
APR	KH=.476	.00001	.00006	.00018	.00041	.00273	.01570	.56076	9.99999	9.99999	9.99999
MAY	KH=.500	.00000	.00005	.00010	.00019	.00094	.00444	.05800	1.00000	9.99999	9.99999
JUN	KH=.471	.00002	.00012	.00026	.00051	.00231	.00902	.09915	1.00000	9.99999	9.99999
JUL	KH=.482	.00001	.00009	.00019	.00036	.00169	.00720	.08258	1.00000	9.99999	9.99999
AUG	KH=.490	.00001	.00005	.00011	.00028	.00146	.00759	.14505	1.00000	9.99999	9.99999
SEP	KH=.460	.00002	.00006	.00024	.00073	.00708	.05514	1.00000	9.99999	9.99999	9.99999
OCT	KH=.459	.00004	.00015	.00059	.00225	.02870	.41046	9.99999	9.99999	9.99999	9.99999
NOV	KH=.264	.00173	.04298	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.357	.00069	.00816	.06948	.67303	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00022	.00434	.08942	.14060	.18745	.32075	.66213	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99978	.99566	.91058	.85940	.81255	.67925	.33787	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00173	.04298	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00003	.00010	.0001	.00094	.00444	.05800	1.00000	9.99999	9.99999

CITY : MUNICH,W GERMANY
LATITUDE : 48.1
TILT ANGLE : 48.1
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day									
	3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
	.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS	46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN KH=.474	.00000	.0000*	.0000*	.00000	.00020	.01268	9.99999	9.99999	9.99999	9.99999
FEB KH=.491	.00000	.0000*	.0000*	.0000*	.00001	.00027	.42147	9.99999	9.99999	9.99999
MAR KH=.488	.00000	.0000*	.0000*	.0000*	.00000	.00002	.01276	9.99999	9.99999	9.99999
APR KH=.476	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00127	.11301	9.99999	9.99999
MAY KH=.500	.00000	.0000*	.0000*	.0000*	.00000	.00001	.00014	.00368	1.00000	9.99999
JUN KH=.471	.00000	.0000*	.0000*	.00000	.00001	.00003	.00053	.01038	9.99999	9.99999
JUL KH=.482	.00000	.0000*	.0000*	.0000*	.00000	.00002	.00034	.00732	1.00000	9.99999
AUG KH=.490	.00000	.0000*	.0000*	.0000*	.00000	.00001	.00034	.01504	9.99999	9.99999
SEP KH=.460	.00000	.0000*	.0000*	.0000*	.00000	.00007	.01417	1.00000	9.99999	9.99999
OCT KH=.459	.00000	.0000*	.0000*	.00000	.00003	.00062	.72923	9.99999	9.99999	9.99999
NOV KH=.264	.00000	.00008	.00370	.21048	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC KH=.357	.00000	.00001	.00018	.00277	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0	.00000	.00001	.00032	.01777	.16669	.16781	.34835	.59579	1.00000	1.00000
ANNUAL AVAILABILITY 0.0	1.00000	.99999	.99968	.98223	.83331	.83219	.65165	.40421	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0	.00000	.00008	.00370	.21048	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0	.00000	.0000*	.0000*	.0000*	.00000	.00001	.00014	.00368	1.00000	9.99999

CITY : MUNICH,W GERMANY
LATITUDE : 48.1
TILT ANGLE : 48.1
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.474	.01338	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.491	.00176	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.488	.00046	.18534	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.476	.00044	.03173	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.500	.00018	.00674	.18419	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.471	.00051	.01176	.30144	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.482	.00036	.01067	.25468	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.490	.00026	.01283	.67783	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.460	.00085	.17385	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.459	.00308	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.264	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.357	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.16844	.45291	.78485	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.83156	.54709	.21515	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00018	.00674	.18419	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : MUNICH,W GERMANY
LATITUDE : 48.1
TILT ANGLE : 48.1
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY (DUTY FACTORS & kWh/day) / # OF DAYS		3.1% .7 6.7	6.3% 1.5 3.3	9.4% 2.2 2.2	12.5% 3.0 1.7	18.8% 4.5 1.1	25.0% 6.0 .8	37.5% 9.0 .6	50.0% 12.0 .4	75.0% 18.0 .3	100.0% 24.0 .2
JAN	KH=.474	.00684	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.491	.00010	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.488	.00001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.476	.00001	.08049	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.500	.00000	.00196	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.471	.00001	.00607	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.482	.00001	.00413	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.490	.00000	.00880	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.460	.00002	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.459	.00026	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.264	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.357	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.16727	.59179	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.83273	.40821	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.00196	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : MUNICH,W GERMANY
LATITUDE : 48.1
TILT ANGLE : 48.1
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day										
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN	KH=.474	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.491	.00940	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.488	.00006	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.476	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.500	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.471	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.482	.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.490	.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.460	.00010	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.459	.02435	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.264	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.357	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.25283	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.74717	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : CAMBRIDGE, U.K.
LATITUDE : 52.2
TILT ANGLE : 52.2
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.333	.00139	.02054	.24265	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.331	.00081	.00737	.05065	.34521	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.376	.00020	.00094	.00442	.01806	.28778	1.00000	9.99999	9.99999	9.99999	9.99999
APR	KH=.394	.00018	.00067	.00195	.00544	.03373	.21023	9.99999	9.99999	9.99999	9.99999
MAY	KH=.443	.00006	.00033	.00069	.00152	.00688	.02692	.35324	1.00000	9.99999	9.99999
JUN	KH=.434	.00008	.00041	.00091	.00187	.00752	.02761	.28217	1.00000	9.99999	9.99999
JUL	KH=.434	.00008	.00041	.00084	.00195	.00781	.02935	.34067	1.00000	9.99999	9.99999
AUG	KH=.396	.00018	.00066	.00181	.00462	.02423	.11747	1.00000	9.99999	9.99999	9.99999
SEP	KH=.407	.00011	.00043	.00149	.00522	.04614	.48342	9.99999	9.99999	9.99999	9.99999
OCT	KH=.384	.00027	.00141	.00737	.03064	.64501	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.292	.00192	.03714	.60922	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.278	.00455	.23783	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00082	.02568	.16017	.28454	.42159	.57458	.83134	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.99918	.97432	.83983	.71546	.57841	.42542	.16866	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00455	.23783	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00006	.00033	.00069	.00152	.00688	.02692	.28217	1.00000	9.99999	9.99999

CITY : CAMBRIDGE, U.K.
LATITUDE : 52.2
TILT ANGLE : 52.2
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day 3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.333	.00000	.00005	.00103	.02343	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.331	.00000	.00002	.00018	.001 1	.24453	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.376	.00000	.00000	.00001	.00004	.00109	.03584	9.99999	9.99999	9.99999	9.99999
APR	KH=.394	.00000	.00000	.00001	.00002	.00019	.00159	.12366	9.99999	9.99999	9.99999
MAY	KH=.443	.00000	.00000	.00000	.00001	.00004	.00016	.00353	.07410	9.99999	9.99999
JUN	KH=.434	.00000	.00000	.00001	.00001	.00006	.00023	.00376	.05810	9.99999	9.99999
JUL	KH=.434	.00000	.00000	.00001	.00001	.00006	.00023	.00424	.07367	9.99999	9.99999
AUG	KH=.396	.00000	.00000	.00001	.00003	.00017	.00112	.04556	1.00000	9.99999	9.99999
SEP	KH=.407	.00000	.0000*	.00000	.00001	.00013	.00198	.73821	9.99999	9.99999	9.99999
OCT	KH=.384	.00000	.00000	.00001	.00308	.00292	.12480	9.99999	9.99999	9.99999	9.99999
NOV	KH=.292	.00000	.00009	.00294	.10629	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.278	.00001	.00064	.11001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.00000	.00007	.00952	.09432	.27076	.34716	.57658	.76716	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		1.00000	.99993	.99048	.90568	.72924	.65284	.42342	.23284	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.00001	.00064	.11001	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00000	.0000*	.00000	.00001	.00004	.00016	.00353	.05810	9.99999	9.99999

CITY : CAMBRIDGE, U.K.
LATITUDE : 52.2
TILT ANGLE : 52.2
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.333	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.331	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.376	.03006	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.394	.00678	.62462	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.443	.00161	.04393	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.434	.00195	.04315	.93291	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.434	.00206	.04772	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.396	.00563	.26661	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.407	.00702	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.384	.05645	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.292	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.278	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.34263	.66884	.99441	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.65737	.33116	.00559	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00161	.04315	.93291	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : CAMBRIDGE, U.K.
LATITUDE : 52.2
TILT ANGLE : 52.2
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		6.7	3.3	2.2	1.7	1.1	.8	.6	.4	.3	.2
JAN	KH=.333	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.331	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.376	.02188	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.394	.00080	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.443	.00007	.05389	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.434	.00011	.04158	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.434	.00011	.05342	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.396	.00054	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.407	.00095	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.384	.09000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.292	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.278	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.34287	.76241	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.65713	.23759	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00007	.04158	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : CAMBRIDGE, U.K.
LATITUDE : 52.2
TILT ANGLE : 52.2
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY	DUTY FACTORS & kWh/day									
	3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
	.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS	8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN KH=.333	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB KH=.331	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR KH=.376	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR KH=.394	.00487	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY KH=.443	.00004	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN KH=.434	.00005	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL KH=.434	.00005	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG KH=.396	.00128	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP KH=.407	.03901	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT KH=.384	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV KH=.292	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC KH=.278	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0	.50378	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0	.49622	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0	.00004	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : JUENEAU, ALASKA
LATITUDE : 58.4
TILT ANGLE : 58.4
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 60.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 20.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		13.3	6.7	4.4	3.3	2.2	1.7	1.1	.8	.6	.4
JAN	KH=.321	.00346	.10278	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.350	.00105	.01017	.07189	.52751	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.391	.00024	.00120	.00582	.02313	.38907	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.428	.00015	.00055	.00153	.00406	.02155	.11099	1.00000	9.99999	9.99999	9.99999
MAY	KH=.402	.00026	.00104	.00262	.00552	.02273	.08497	1.00000	9.99999	9.99999	9.99999
JUN	KH=.392	.00032	.00131	.00292	.00618	.02369	.08111	.85723	9.99999	9.99999	9.99999
JUL	KH=.371	.00046	.00179	.00427	.00930	.03795	.14112	1.00000	9.99999	9.99999	9.99999
AUG	KH=.349	.00067	.00216	.00642	.01681	.09300	.51750	9.99999	9.99999	9.99999	9.99999
SEP	KH=.325	.00059	.00313	.01491	.06233	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.284	.00161	.02411	.28061	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.280	.00515	.21738	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.228	.44059	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.03788	.11380	.28258	.38790	.54900	.66131	.98810	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.96212	.88620	.71742	.61210	.45100	.33869	.01190	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		.44059	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00015	.00055	.00153	.00406	.02155	.08111	.85723	9.99999	9.99999	9.99999

CITY : JUENEAU, ALASKA
LATITUDE : 58.4
TILT ANGLE : 58.4
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 40.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 35.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS		46.7	23.3	15.6	11.7	7.8	5.8	3.9	2.9	1.9	1.5
JAN	KH=.321	.00001	.00031	.02007	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.350	.00000	.00003	.00032	.00357	.54869	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.391	.00000	.00000	.00001	.00006	.00175	.05992	9.99999	9.99999	9.99999	9.99999
APR	KH=.428	.00000	.00000	.00001	.00002	.00012	.00087	.04144	1.00000	9.99999	9.99999
MAY	KH=.402	.00000	.00002	.00004	.00007	.00032	.00144	.02566	.48843	9.99999	9.99999
JUN	KH=.392	.00000	.00003	.00006	.00011	.00044	.00172	.02412	.31833	9.99999	9.99999
JUL	KH=.371	.00000	.00003	.00008	.00017	.00074	.00336	.05543	1.00000	9.99999	9.99999
AUG	KH=.349	.00000	.00003	.00008	.00020	.00147	.01053	.54293	9.99999	9.99999	9.99999
SEP	KH=.325	.00000	.00001	.00006	.00033	.01066	.39765	9.99999	9.99999	9.99999	9.99999
OCT	KH=.284	.00000	.00007	.00138	.03081	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.280	.00001	.00074	.08829	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.228	.00019	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
	LP	.00002	.08344	.09253	.25295	.38035	.45629	.64080	.90056	1.00000	1.00000
	Y	.99998	.91656	.90747	.74705	.61965	.54371	.35920	.09944	0.00000	0.00000
		.00019	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
		.00000	.00000	.00001	.00002	.00012	.00087	.02412	.31833	9.99999	9.99999

CITY : JUENEAU, ALASKA
LATITUDE : 58.4
TILT ANGLE : 58.4
LOAD (WATTS) : 2000.
ARRAY AREA (SQ. METERS) : 13.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY		DUTY FACTORS & kWh/day									
		3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
		1.5	3.0	4.5	6.0	9.0	12.0	18.0	24.0	36.0	48.0
# OF DAYS		3.3	1.7	1.1	.8	.6	.4	.3	.2	.1	.1
JAN	KH=.321	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.350	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.391	.03961	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.428	.00477	.25894	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.402	.00643	.15066	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.392	.00706	.13455	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.371	.01092	.26245	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.349	.02167	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.59999
SEP	KH=.325	.11772	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.284	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.280	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.228	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0		.43402	.73388	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0		.56598	.26612	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0		9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0		.00477	.13455	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : JUENEAU, ALASKA
LATITUDE : 58.4
TILT ANGLE : 58.4
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 5.0
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 5.0

BATTERY CAPACITY / # OF DAYS		DUTY FACTORS & kWh/day 3.1% .7 6.7	6.3% 1.5 3.3	9.4% 2.2 2.2	12.5% 3.0 1.7	18.8% 4.5 1.1	25.0% 6.0 .8	37.5% 9.0 .6	50.0% 12.0 .4	75.0% 18.0 .3	100.0% 24.0 .2
JAN	KH=.321	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB	KH=.350	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR	KH=.391	.03819	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR	KH=.428	.00041	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY	KH=.402	.00075	.39601	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN	KH=.392	.00094	.25269	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL	KH=.371	.00190	1.00000	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG	KH=.349	.00625	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP	KH=.325	.30408	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT	KH=.284	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV	KH=.280	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC	KH=.228	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP	0.0	.44604	.88739	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY	0.0	.55396	.11261	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS	0.0	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS	0.0	.00041	.25269	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

CITY : JUENEAU, ALASKA
LATITUDE : 58.4
TILT ANGLE : 58.4
LOAD (WATTS) : 1000.
ARRAY AREA (SQ. METERS) : 3.5
ARRAY EFFICIENCY (%) : 10.0
BATTERY EFFICIENCY (%) : 75.0 BATTERY CAPACITY (kWh) : 6.0

BATTERY CAPACITY / # OF DAYS	DUTY FACTORS & kWh/day									
	3.1%	6.3%	9.4%	12.5%	18.8%	25.0%	37.5%	50.0%	75.0%	100.0%
	.7	1.5	2.2	3.0	4.5	6.0	9.0	12.0	18.0	24.0
# OF DAYS	8.0	4.0	2.7	2.0	1.3	1.0	.7	.5	.3	.3
JAN KH=.321	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
FEB KH=.350	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAR KH=.391	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
APR KH=.428	.00103	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
MAY KH=.402	.00084	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUN KH=.392	.00089	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
JUL KH=.371	.00308	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
AUG KH=.349	.05714	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
SEP KH=.325	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
OCT KH=.284	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
NOV KH=.280	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
DEC KH=.228	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL AVG. LOLP 0.0	.58858	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
ANNUAL AVAILABILITY 0.0	.41142	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ANNUAL LOLP MAXIMUMS 0.0	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999
ANNUAL LOLP MINIMUMS 0.0	.00084	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999	9.99999

APPENDIX B

STRUCTURAL ANALYSIS

A CHECKLIST FOR THE ANALYSIS OF THE MERADCOM STRUCTURE

Will the trailer overturn in the wind

Will the trailer overturn when taking normal turns at high towing speeds

Will the tie-downs hold during movement over rough terrain

Will the support rods hold during winds from the front and back

Will the support have lateral stability for winds from the side

Will the trailer fill with rain closed or open

What strengthening is required for the trailer to hold the batteries

How strong must the fold-out arms be

How strong must the outriggers be

How strong must the pinned joints of the foldout arms be

How tolerant will the design be to uneven terrain

Are the erection forces higher than the normal forces

Will the structure buckle -- especially the support rods

What is the most severe tilt including wind loads and the angle of the support

How load-bearing must the soil be

Will cannon fire impose severe loads on the structure (e.g., lateral loads

How will the structure behave under wind gusts -- what is the natural frequency as compared to the vortex shedding frequency

Will the structure hold one man standing on it -- for repairs, construction or against instructions

Are the transporting loads higher than the erected loads

What are the hold-down loads

Can the batteries be placed along the centerline, or must they be located near the axle

What is the natural frequency of the battery/trailer combination

Keep the c.g. near the axle for ease of towing and rotating once on site

What are the best materials to be used

From what height can the trailer be dropped without damaging the power system

How will the panels be installed and supported along the slant height

Is a horizontal brace needed to keep the rails from spreading apart - will a wire suffice or must a compression member also be provided

How will the back brace resist lifting with a wind from the rear

How will the front brace resist lifting with a wind from the front

Should guy wires by used to resist the uplift/overturning

Can the array and trailer be rotated after erection or are the loads too great

Perform rigid-body analyses as well as deformable-body analyses

Take the wind-load data from recent reports

Watch the dead weight as well as the live load

FORCES ON THE COLLECTORS

According to a study of array wind loads performed by Boeing, the combined front and rear (suction) forces could result in normal force coefficients of 2.0. Values of 2.5 were measured by VPI investigators, who performed tests of wind-tunnel models. The negative implies the force (and wind) are from the rear. Cp of 1.51 was observed when the wind was from the front. Gusts giving Cp = -3.93 to 5.61 occurred.

At a wind velocity of 60 knots (101 FPS), the wind pressure is 14.63 PSF. For now, we will assume the structure to be flexible enough to withstand the gusts; however, we will design to Cp = -3.05 to +3.05 to provide sufficient safety factor. Then the wind force is ± 44.6 PSF.